No: 102 September 1997

SPECTRAL IRRADIANCE, RADIANCE AND POLARIZATION DATA FROM THE NORDIC CRUISE IN THE MEDITERRANEAN SEA DURING JUNE-JULY 1971

Eyvind Aas
Niels K. Højerslev
Bo Lundgren

INSTITUTT FOR GEOFYSIKK

UNIVERSITETET I OSLO

INSTITUTE REPORT SERIES

e s.trykk-Oslo

No: 102 September 1997

SPECTRAL IRRADIANCE, RADIANCE AND POLARIZATION DATA FROM THE NORDIC CRUISE IN THE MEDITERRANEAN SEA DURING JUNE-JULY 1971

Eyvind Aas
Niels K. Højerslev
Bo Lundgren

Eyvind Aas, University of Oslo, Department of Geophysics, PO Box 1022
Blindern, N-0315 Oslo, Norway

Niels K. Højerslev, University of Copenhagen, Niels Bohr Institute of Astronomy,
Physics and Geophysics, Department of Geophysics, Juliane Maries Vej 30,
DK-2100 Copenhagen Ø, Denmark

Bo Lundgren, Denmark's Fisheries Research, Nordsøcentret,
PO Box 101, DK-9850 Hirtshals, Denmark

Contents

PART 1. METHODS AND RESULTS

PART 2. TABLES FOR IRRADIANCE
AND QUANTITIES DERIVED FROM IRRADIANCE

PART 3. TABLES FOR RADIANCE
AND QUANTITIES DERIVED FROM RADIANCE

Foreword - The Nordic Collegium for Physical Oceanography

The Nordic Collegium for Physical Oceanography (NKFO) was constituted in 1965. Its first members were Professors Ilmo Hela (Helsinki, Finland), Nils G. Jerlov (Copenhagen, Denmark), Börje Kullenberg (Gothenburg, Sweden) and Håkon Mosby (Bergen, Norway). (The initiator was Mosby, and his original plan had been to establish a joint Nordic institute for physical oceanographic research, but this idea, which was approved by the other Nordic professors, was not supported at governmental level). Through the years the members of the collegium have changed, and the representatives from the different countries have been:

Denmark: N. G. Jerlov, G. Kullenberg, N. K. Højerslev
Finland: I. Hela, H. Simojoki, J. Virta, A. Voipio, E. Palosuo, J. Launiainen, P. Mälkki, K. Kahma
Norway: H. Mosby, O. H. Sælen, A. Foldvik, H. G. Gade, J. E. Weber
Sweden: B. Kullenberg, P. Welander, G. Walin, P. Lundberg, J. Rodhe

The purpose of NKFO was to support collaboration in teaching and research in physical oceanography between the Nordic universities. The first annual budget of NKFO in 1966 was $ 28,000 (195,000 NOK), and the last budget in 1993 had increased to $ 150,000 (1,040,000 DKK), yet both sums are rather small compared with the costs of their times. Nevertheless very efficient use was made of the available means, mostly because there were practically no administrative expenses, and the collegium became a great success. Several meetings for the discussion of teaching and research were arranged, as well as special doctoral courses for the Nordic students. Many scholarships and research grants were given, and the list of scholars constitutes a "Who's Who" in Nordic oceanography:

Denmark: B. Lundgren, N. K. Højerslev, N. Berg Olsen, B. Hammer Jensen, T. Schelde Jacobsen, P. B. Nielsen, E. Buch, J. H. Hansen, K. Mortensen, T. Jensen, J. Holm, P. Sloth, L. Hansen, S. Folving, N. C. Jensen, J. Mortensen, O. Krarup Leth
Faroe Islands: B. Hansen, K. Simonsen
Finland: S. Uusitalo, H. Cronström, M. Autio, M. Tyrvainen, P. Alenius, A. Valli, J. Haapala, A. Herlevi
Iceland: B. Erlingsson, B. Arnvidarsson, S. Jonsson
Norway: R. Leinebø, Ø. Stenvaag, H. Thomsen, H. Svendsen, N. P. Fjeldstad, G. Furnes, H. Loeng, L. I. Eide, F. E. Dahl, E. Aas, A. K. Magnusson, S. Østerhus, H. Søiland, I. Moen
Sweden: H. Westerberg, B. Rudels, J. Rodhe, A. Stigebrandt, L. Rydberg, L. A. Rahm, A. Larsson, P. Lundberg, B. Sjöberg, J. Magnusson, S. Sjöstedt, K. Borenäs, L. Funquist, J. Mattsson, L. Lundberg, B. Gustavsson
USA: M. Brown

The most important aspect of NKFO probably was that it established contacts very effectively between the Nordic oceanographers and created a forum where common problems could be discussed. It was too good to last. The financial support to the collegium was closed down in 1993 by the Nordic Ministerial Council.

***

In 1968 NKFO arranged a symposium where the programme for a joint Nordic expedition to the Mediterranean was discussed. Two years later Finland and Sweden withdrew from the project, which thus became a Danish-Norwegian expedition. The main subjects to be studied were bottom currents in the Straits of Gibraltar, mixing processes in the surface layer and optical conditions in the Western Mediterranean.

The r/v "Helland-Hansen" left Bergen on April 20, 1971, and returned on September 3 the same year. The crew was: Magnus Hauge, captain; Birger Biskopshavn, mate; Leif Herland, chief, Asbjørn Næss, engineer; Åsvald Haugland, deck hand; "Store-Knut" Angeltveit, deck hand; Arthur Peder Småge, steward. The name of the messboy has been lost.

The cruise consisted of eight parts with different scientific staffs. The participants were (underlined names are cruise leaders):

Denmark: N. Berg Olsen, T. Frovin, J. Holck, N. K. Højerslev, N. G. Jerlov, O. Kristensen, G. Kullenberg, B. Lundgren, A. Nielsen, K. Nygård
Norway: E. Aas, G. Bøyum, N. P. Fjeldstad, A. Foldvik, H. G. Gade, H. Helle, H. O. Hermansen, T. Kvinge, R. Michelsen, J. Molvær, M. Mork, A. Revheim, F. Svendsen, H. Svendsen, O. H. Sælen, N. Utne
Sweden: T. Rossby, H. Westerberg
USA: W. S. Plank, R. C. Smith, J. R. V. Zaneveld

(We are due thanks to Professor Odd Henrik Sælen who has provided most of the information about the Nordic Collegium).

***

This report will probably present the final observations from the Nordic Mediterranean Cruise. The authors humbly wish to dedicate it to the memory of the four founders of the collegium, who clearly saw the advantages of Nordic collaboration.

PART 1. METHODS AND RESULTS

1. Introduction

During the Nordic Mediterranean Cruise in 1971 optical measurements were made from May 29 to July 13, in an area from the west of Sicily to the south of Malaga. Most of the results were presented immediately after the cruise. Observations of the volume scattering function made by Kullenberg and corresponding observations of the particle size distribution by Plank and Zaneveld were published by Kullenberg and Berg Olsen (1972). Højerslev presented a paper (1973) where the different terms of the Gershun equation had been measured in order to determine the absorption coefficient and its spectral variation, together with vertical profiles of the attenuation and scattering coefficient. Jerlov introduced the colour index and related it to observations of quanta and blue irradiance made during the Mediterranean cruise (Jerlov, 1974a,b; Højerslev and Jerlov, 1977). The details of the quanta and blue irradiance observations were studied by Højerslev (1974). Smith (1974) obtained the underwater radiance distribution from photographic measurements with a fish-eye lens.

This paper presents spectral irradiance, radiance and polarization measurements, which constitute the remaining part of the fairly large and complete marine optical data set listed above. More details are offered in Chapter 3.1. The value of the data set is twofold: Such sets are rare, and it also provides an opportunity to detect long-term changes in the optical conditions by comparing it with present-day observations.

2. Instruments and errors in measurements

2.1. Irradiance meter

The sensor part of the irradiance meter consists of a cosine collector (opal glass), 8 double interference filters, 3 neutral (grey) filters, and a photomultiplier (Fig. 1). The instrument has been described in more detail by Jerlov (1965) and Lundgren and Højerslev (1971). Both downward irradiance E_d and upward irradiance E_u can be measured, the latter quantity by turning the instrument upside down.

The cosine properties of opal glass in water have been investigated in the UV, green and red parts of the spectrum by Jerlov and Nygård (1969). The opal tends to underestimate the irradiance contribution from the radiance when the angle of incidence increases, as compared with a radiance of normal incidence. From our observed angular distributions of radiance the total underestimation of E_d seems to be 5%-10%, and of E_u 15%-25%. As a result the irradiance ratio $R=E_u/E_d$ becomes underestimated by 10%-20%. The larger errors occur for UV light and the smaller for green light, with the errors for red light between these.

In the blue part of the spectrum the cosine properties of opal were investigated by Høkedal and Aas (1994), and from their results the corresponding underestimation of R will be around 10%.

The ratio between the sensitivities of the irradiance meter in water and air is defined as the immersion coefficient. For most sensors, where only one side of the cosine collector is exposed to water/air contact, this coefficient obtains values in the range 0.6-0.8 (Smith, 1968, Aas, 1969). The construction of the present cosine collector differs in that both sides of the opal are open to the surrounding medium, that is the opal will be surrounded by air when the instrument is in air, and surrounded by water when the instrument is submerged in water (Fig. 1). The resulting immersion coefficient was measured to be 1.0 for all wavelengths.

Eight interference filters could be mounted on a disk which revolved in front of the photomultiplier. During the cruise two different sets of filter disks were applied. Before July 4 the wavelengths in nm of the peak transmittances were:

Disk 1: 371 - 533 - 548 - 574 - 601 - 630 - 649 - 693
Disk 2: 429 - 454 - 465 - 474 - 489 - 502 - 513 - 528

After July 4 the wavelengths were:

Disk 1: 429 - 533 - 548 - 574 - 601 - black - 649 - 693
Disk 2: 371 - 454 - 465 - 474 - 489 - 502 - 513 - 630

The bandwidths of the filters at half peak transmittance varied from 6 to 20 nm at the shortest and longest wavelength respectively.

Three different grey filter combinations were applied: 0, 1, and 2 grey filters. Each grey filter reduced the signal to 3.0%. Combined with the variable high voltage supply to the photomultiplier, the sensor was able to measure irradiance over a range of 7 decades.

For each setting of high voltage, filters and recorder sensitivity there was a linear relation between the irradiance and the amplified signal. The irradiance sensor was not calibrated in absolute units, but in the tables the irradiance has been presented in units relative to the surface value.

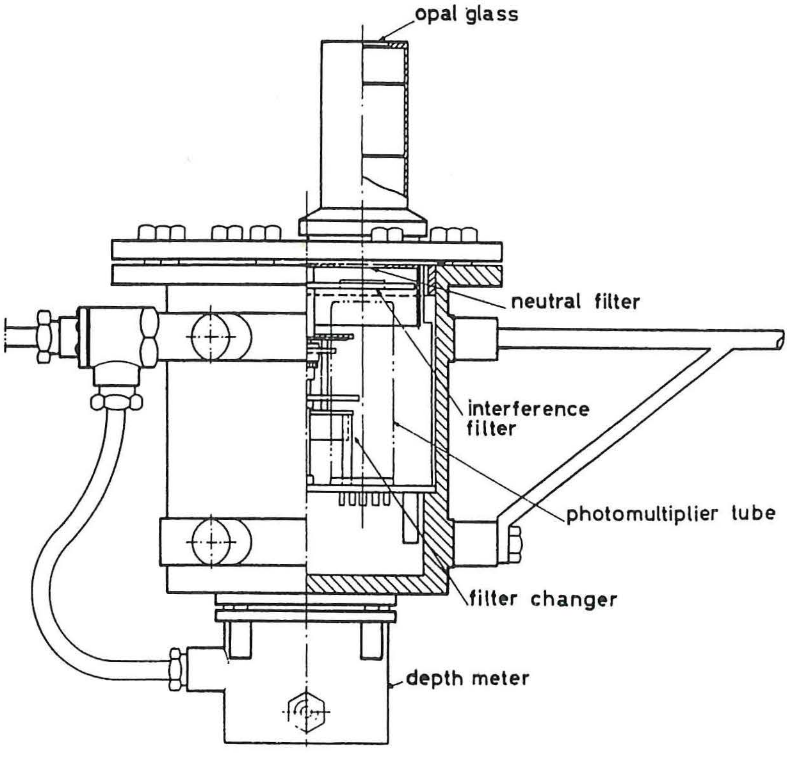


Fig. 1. The spectral irradiance meter (Jerlov, 1965).

2.2. *Radiance meter*

The radiance meter consists of a housing with 4 parallel radiance tubes mounted on gimbals (Fig. 2). Each tube is equipped with polarization filters, double interference filters, grey filters and a lense f/2.8, 85 mm which accepts light from within a total opening angle in water of 1.4°. The tubes can be set at different zenith angles θ in steps of 2°, ranging from 0 to 180°. For each fixed θ, the radiance is rotated around the vertical cable giving the azimuthal dependence of L. In this way the total radiance field is obtained together with a combined measurement of the four Stokes parameters leading to a determination of the degree of polarization. A more detailed description has been given by Lundgren (1971).

The interference filter could be selected by a rotating disk with 8 different filters. Two different disks were used during the cruise:

Disk 1: hole - 371 - 405 - 428 - 454 - 474 - 488 - 502
Disk 2: 547 - 575 - 599 - 628 - 648 - 465 - 512 - 533

One or two grey filters, each with a transmittance of 3.8%, could be added.

Because an almost logarithmic amplification of the radiance signal was applied in combination with the grey filters, the instrument was able to measure radiance over a range of 9 decades.

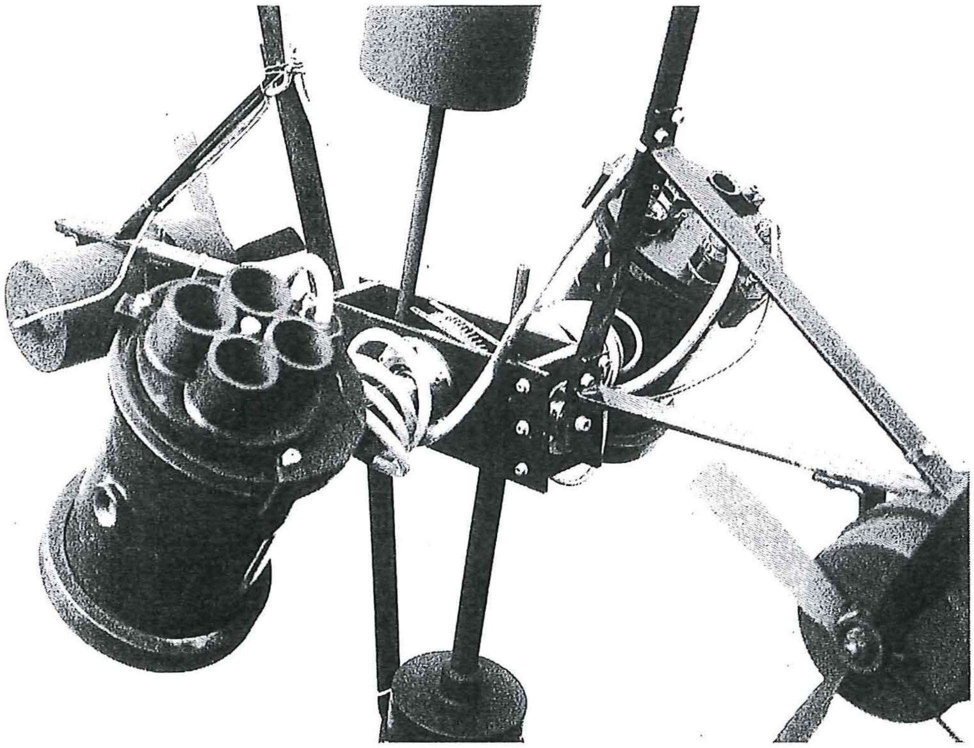


Fig. 2. The spectral radiance meter. In the foreground the housing with the four radiance tubes can be seen, and the housing in the background contains electronics. Two sets of propellers rotate the whole instrument around the vertical.

2.3. Influence of ship on measurements

The length of r/v Helland Hansen was 34 m, the width 6.5 m, the height above water approximately 5 m and the depth below the surface 2.5 m. A bar about midships kept the spectral irradiance and radiance meters at a distance of 6.5 m out from the ship rail. (Blue and quanta irradiances were measured astern, as shown in Fig. 3).

All direct in-water radiance from the upper hemisphere above the surface is contained within the Snell cone Ω_S, defined by:

$$\Omega_S = 2\pi \int_0^{48.4°} \sin\theta \, d\theta \tag{1}$$

The fraction of the Snell cone that contains parts of the underwater ship hull, $\Omega_{S,hull}$, has been calculated, and the ratio $\Omega_{S,hull}/\Omega_S$ is presented in Table 2.3.

In the upper layer of the sea, downward irradiance will be dominated by the radiance contribution within the Snell cone. The presence of a ship within the Snell cone may thus reduce the irradiance significantly. If the radiance were constant within the Snell cone, the error would be equal to the relative fraction $\Omega_{S,hull}/\Omega_S$. It can be seen from Table 2.3 that the largest error of the recorded irradiance is likely to occur at a depth of 10 m where the

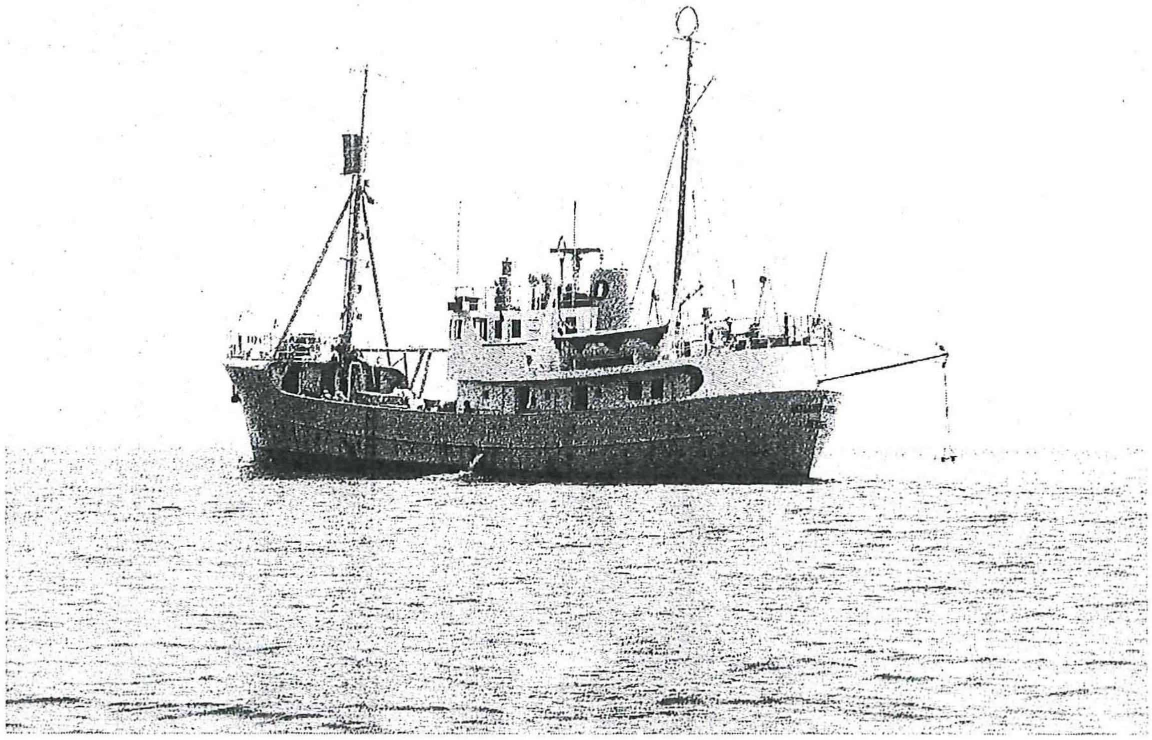


Fig. 3. R/v "Helland-Hansen" in the Mediterranean. The quanta irradiance and the blue irradiance (465 nm) are about to be measured astern. Hydrocasts and spectral irradiance and radiance measurements were made midships on the sunny side.

ratio $\Omega_{S,hull}/\Omega_S$ is equal to 19%. This means that in cloudy weather the error in recorded downward irradiance may be in the order of magnitude of 20%, while a clear sky probably will reduce the error to less than half of this value, with the smallest error at the longest wavelengths where the direct solar irradiance dominates. Since our measurements were made in sunny weather, ship-shading errors on the irradiance can be disregarded.

The radiance from directions containing the ship hull will be more strongly influenced by this effect. At 655 nm the optical length $1/c$, where c is the beam attenuation coefficient, was observed to be about 2-3 m (Højerslev, 1973), and at 465 nm it has been estimated to vary in the range 6-14 m. The direct signal from the ship will be negligible at a distance of 3-4 optical lengths, that is at 25-50 m depth for blue light, and practically at all depths for red light.

At shallow depths the shading effect of the ship could sometimes be identified as a sudden downward jump of the recorded signal. By tentatitive extrapolation or interpolation of the signal this error could to some extent be accounted for. However, a significant uncertainty will remain in these recordings.

Table 2.3.1. Fraction of the solid angle from instrument to ship within the Snell cone (θ=zenith angle; r_{min}=minimum distance from instrument to ship; $\Omega_{S,hull}/\Omega_S$=solid angle fraction)

Depth m	θ from instrument to underwater hull °	r_{min} m	$\Omega_{S,hull}/\Omega_S$ %
1	80-100	6.5	0
5	50-80	8	0
10	30-60	11	19
25	15-30	25	10
50	7-15	48	1.3
100	3-8	98	0.8

2.4. *Self-shading effect*

Radiance and irradiance meters may "see" their own shadows when they are directed downwards in the sea, and thus receive a reduced radiant flux. Gordon and Ding (1992) found using Monte Carlo simulations that the relative error ϵ due to the shading effect could be approximated by the function

$$\epsilon = 1 - e^{-k'a\rho} \tag{2}$$

where a is the absorption coefficient, ρ is the instrument radius, and k' is a quasi-constant which is a function of the solar zenith angle, the ratio between diffuse sky irradiance and direct solar irradiance above the sea surface, the single-scattering albedo, and the product $a\rho$. Field validations of a similar relationship have been presented by Aas and Korsbø (1997).

The radius of the instrument housing is about 13 cm, while the window of the radiance tubes has a radius of 2 cm. From the derived values of a in Part 2-3 the average self-shading error of nadir radiance has been estimated to be in the range 1-2%, with a maximum error of about 6%. Radiance observations in the exact anti-sun direction may obtain larger errors, but there are few such observations in our data set.

The self-shading error of upward irradiance has similarly been estimated to be about 1% or less in the blue part of the spectrum, with a maximum of about 5% in the red part.

2.5. Depth recordings

Depth was set equal to the wire length recorded by a meter wheel. On a few occasions wire angels of up to 30° from the vertical were observed. This could result in reductions of the depth by about 10% (Mosby, 1952, 1955). However, at most of the stations such effects were negligible, and all depths presented in the tables of this report are uncorrected.

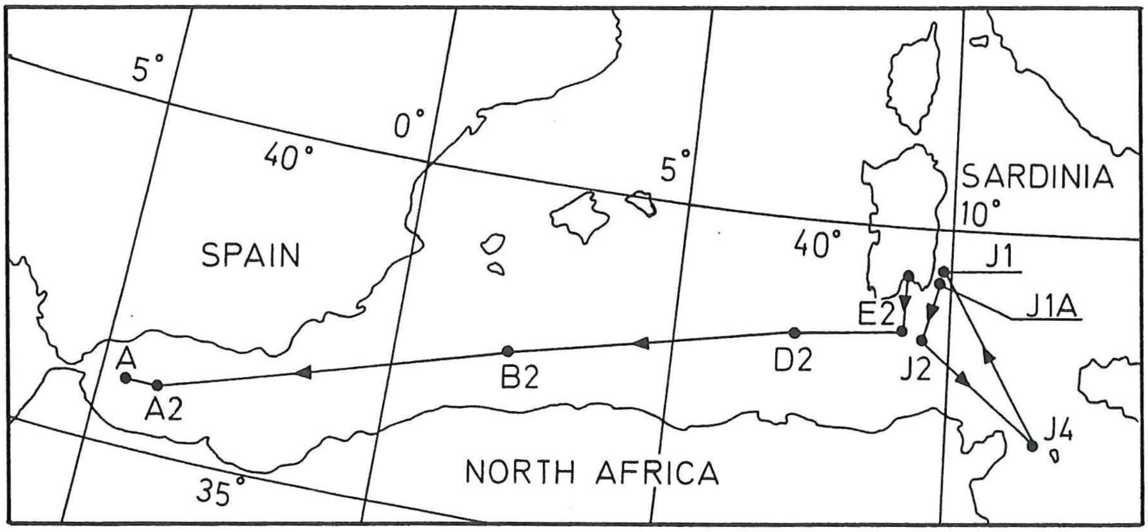


Fig. 4. Location of the stations during the second optical cruise leg from June 24 to July 13, 1971 (Højerslev, 1974).

3. Material and methods

3.1. *Stations and observed quantities*

This report presents observations made during the second leg of the optical cruise. Positions of the stations are presented in Fig. 4 and Table 3.1.1. The table also presents the weather conditions, and the sea state and cloudiness are described in WMO code. Further details of the measurements are given in the tables of Parts 2 and 3. Information about the first leg of the cruise is offered in Table 3.1.2.

3.2. *Solar time and altitude*

Solar altitude h is related to solar declination δ (Table 3.1), local latitude ϕ (Table 3.1), and the sun's hour angle ω, by the equation

$$\sin h = \sin\delta \sin\phi + \cos\delta \cos\phi \cos\omega \tag{3}$$

The hour angle is a linear function of the true solar time t:

$$\omega = [15\,^\circ\, hr^{-1}]\,(t - 12) \tag{4}$$

where t is defined so that h_{max} occurs at $t=12$ when $\omega=0$. From Eq. 3 it can be found that h_{max} is determined by δ and ϕ:

$$h_{\max} = \frac{\pi}{2} - (\phi - \delta) \tag{5}$$

The solar altitude was frequently measured, and thus the ship time noted in the recordings could be converted to solar time.

Eq. 3 defines the astronomical solar angle. At low solar altitudes, however, the observed angle will be somewhat higher due to refraction of the solar rays in the atmosphere. The applied corrections are presented in Table 3.2.1.

3.3. *Normalization of irradiance and radiance recordings*

The recorded irradiance signal (x) depended on the magnitude of the incident irradiance (E), but it was also a function of the transmittances of the applied opal glass (cosine collector), interference filter, and grey filters ($T_o T_i T_g \Delta\lambda$, where $\Delta\lambda$ is the band width of the interference filter), the amplification due to the selected high voltage supply to the photomultiplier (f), the spectral sensitivity of the photomultiplier (s) and the selected sensitivity of the recorder (S):

$$x = E\, T_o\, T_i\, T_g\, \Delta\lambda\, f\, s\, S \tag{6}$$

The readings were normalized to one reference condition with regard to T_o, T_g, f, and S, so

Table 3.1.1. Observations during the cruise from June 24 to July 13 (δ=solar declination; E=downward and upward spectral irradiance[a]; E_{blue}=downward irradiance at 465 nm[b]; q=downward quanta irradiance 350-700 nm[b]; L=spectral radiance[a]; P=spectral polarization[a]; β=volume scattering function[c]; c=attenuation coefficient[d]; b=scattering coefficient[d]; t=temperature[d]; F=colour index[e]; $\beta(45°)$=Tyndall measurement[d])

Sta.	Date (1971)	δ °	Position	Depth m	Weather	Measured quantities
J1	6-24	23.5	N 39°22’	1040	N 2 m/s	E, E_{blue}, q
	6-25	23.5	E 09°48’		Sea 1	E
	6-26	23.4			haze-clear	E, L, E_{blue}, q
J2	6-27	23.4	N 38°20’	1860	N 2 m/s	E_{blue}, q
	6-28	23.4	E 09°31’		Sea 1	E, E_{blue}, q
					haze	
J2A	7-2	23.1	N 38°22’	1860	E 3 m/s	L, P
			E 09°31’		Sea 1-2	
					haze-clear	
E2	7-6	22.8	N 38°34’	1100	N 8-10 m/s	E, L, P, E_{blue}, q, β, c
			E 09°09’		Sea 3-4	
					Cloud 3	
D2	7-7	22.7	N 38°23’	2600	NW 4 m/s	L, P, E_{blue}, q, β, c, b, t
	7-8	22.6	E 07°10’		Light swell	L, P, E_{blue}, q, β, c, b, t, F
					clear	
B2	7-10	22.4	N 37°30’	2700	NE 2 m/s	L, E_{blue}, q, β, $\beta(45°)$, t
			E 02°10’		Sea 2	
					Cloud 3	
A2	7-12	22.1	N 36°09’	1300	W 0-3 m/s	E, L, P, E_{blue}, q, β, c, b, F
	7-13	22.0	W 04°00’		Sea 1	E, L, P, β, b, $\beta(45°)$, t, F
					clear	

---

[a] Presented in this report; [b] Højerslev (1974); [c] Kullenberg and Berg Olsen (1972); [d] Højerslev (1973); [e] Jerlov (1974a).

Table 3.1.2. Observations during the cruise from May 29 to June 17 (E_o=scalar irradiance[d]; S=salinity[d]; for explanation of other symbols and references see Table 3.1.1)

Sta.	Date (1971)	δ °	Position	Depth m	Weather	Measured quantities
A	5-29 5-30 6-1	21.6 21.7 22.0	N 36°00' W 04°30'	800	Calm Sea 0 clear	E, E_o, E_{blue}, q, F β, b, $\beta(45°)$, c, t, S
B	6-2	22.2	N 37°20' E 02°10'	2800	NW 10 m/s Sea 3-4 cloudy	$\beta(45°)$, t, S
C	6-3	22.3	N 38°11' E 03°06'	2800	NW 10 m/s strong swell Cloud 8	E, E_o, F, β, $\beta(45°)$, t, S
D	6-5	22.5	N 38°07' E 06°07'	2600	W 10 m/s Sea 3-4 cloudy	E, E_o
J1A	6-12 6-13	23.2 23.2	N 39°17' E 09°42'	650	NW 7 m/s Sea 2 Cloud 2	E, E_o, E_{blue}, q, F b, c, t, S
J2	6-14 6-15	23.3 23.3	N 38°20' E 09°31'	1860	E 7 m/s Sea 3 clear	E, E_o, E_{blue}, q, F b, c, t, S
J4	6-17	23.4	N 36°55' E 11°37'	760	NW 2 m/s Sea 3 haze-clear	E_{blue}, q

that the normalized irradiance E/E_r obtained the form

$$\frac{E}{E_r} = \frac{E}{1/(T_o\ T_i\ \Delta\lambda\ s)} = \frac{x}{T_g\,f\,S} \tag{7}$$

It is emphasized that T_o for irradiance measurements in air is always equal to or higher than T_o for irradiance measurements in water due to the immersion effect (see p.6).

In each case of the radiance measurements two values of the radiance $L(\theta)$ were read for each selected zenith angle θ: $L(\theta+)$ in the solar plane with the same azimuth as the sun, and $L(\theta-)$ in the solar plane opposite to the sun. The degree of polarization, P,

Table 3.2.1. Corrected solar altitude

Astr. *h*	Correction	Corr. *h*
- 0.6°	+ 0.6°	0°
+0.6	0.4	1.0
1.7	0.3	2.0
2.8	0.2	3.0
3.8	0.2	4.0
5.9	0.1	6.0
7.9	0.1	8.0
9.9	0.1	10.0
14.9	0.1	15.0
20.0	0.0	20.0

was also read for the same directions. The radiance is presented in normalized values L/L_r by an expression similar to Eq. 7.

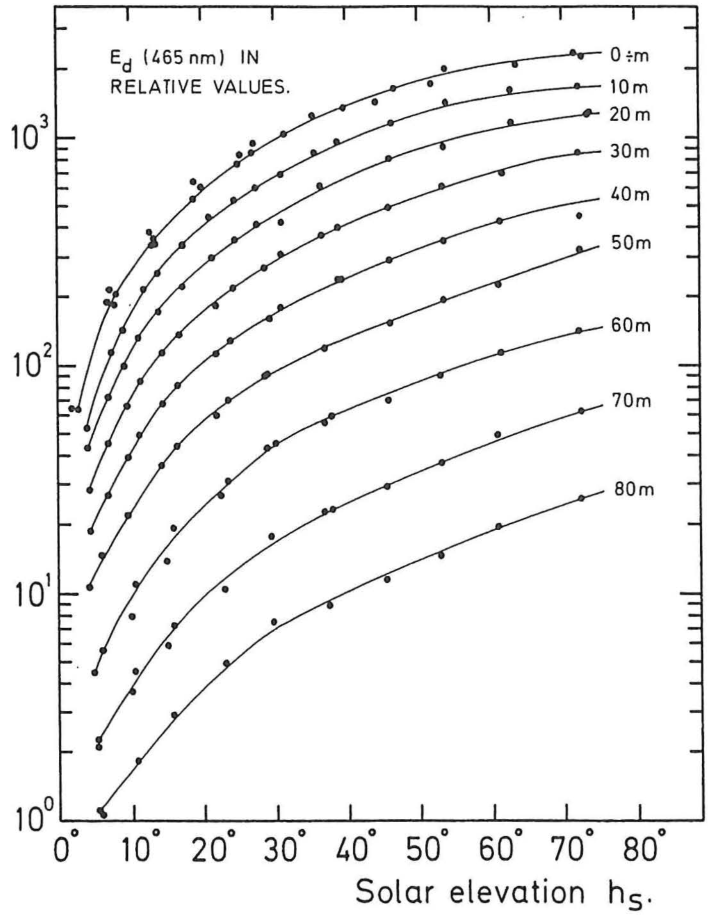


Fig. 5. Blue downward irradiance (465 nm) at different depths versus solar elevation h_s (Højerslev, 1974). A difference of 10° in h_s corresponds to a difference in time of 53 minutes.

3.4. Interpolation of observations

The solar altitude will usually change significantly (2°-5°) during a series of radiance measurement at a chosen depth, but because the angular radiance distribution in the upper hemisphere is very sensitive to the sun's position and difficult to predict, no attempts to interpolate or normalize the radiance observations to one reference position of the sun have been made.

Irradiance, on the other hand, is directionally integrated radiance, and thus less sensitive to changes in the solar position. A whole series of irradiance measurements from the surface to a depth of 100 m and back to the surface would typically require 1 hour. The measurements were interpolated linearly to the observation time t_2 for the deepest observation. If E_1 is the irradiance observed on the way down at time t_1 at a certain depth, and E_3 is the corresponding irradiance observed on the way up at time t_3, the interpolated value E_2 at the reference time t_2 becomes

$$E_2 = E_1 + \frac{E_3 - E_1}{t_3 - t_1}(t_2 - t_1) \tag{8}$$

Both the downward irradiance E_d and the upward irradiance E_u have been interpolated by Eq. 8 for periods equal to or less than one hour. In an earlier report (Højerslev, 1974) blue downward irradiance was found to vary in a very regular way as a function of the solar elevation, and Fig. 5 indicates that the time dependency for such short periods may be approximately linear.

The time span between two similar series of irradiance measurements was typically 2-3 hours, and the linear interpolation method was then judged as being too uncertain. Just beneath the surface the downward quanta irradiance Q has been observed to follow an average relationship of the form

$$Q = Q_0 \sin^{1.4} h \tag{9}$$

where h is the solar altitude (Højerslev, 1980). If the downward spectral irradiance E_d follows a solar dependency of the type suggested by Eq. 9, the interpolated irradiance E_2 at the reference time t_2 and solar altitude h_2 may be expressed as

$$E_2 = E_1 \left(\frac{\sin h_2}{\sin h_1}\right)^{1.4} = E_3 \left(\frac{\sin h_2}{\sin h_3}\right)^{1.4} \tag{10}$$

However, because the vertical attenuation will change somewhat with a change in h, Eq. 10 cannot be applied deeper down in the water column. A compromise between Eqs. 9 and 11 is the hybrid interpolation formula

$$E_2 = E_1 \left(\frac{\sin h_2}{\sin h_1}\right)^{1.4} \frac{t_3 - t_2}{t_3 - t_1} + E_3 \left(\frac{\sin h_2}{\sin h_3}\right)^{1.4} \frac{t_2 - t_1}{t_3 - t_1} \tag{11}$$

provided that the observation times t_1 and t_3 both are on the same side of noon.

If $h_1 \approx h_2 \approx h_3$, Eq. 11 will coincide with Eq. 8, and if E_2 follows Eq. 10, Eq. 11 will be reduced to Eq. 10. Downward irradiance at 465 nm is shown as a function of solar elevation in Fig. 5. Except around noon there was practically a linear relation between time and solar elevation at our stations, and the figure indicates that linear interpolation may be a fairly reasonable method for time intervals of less than one hour when the sun is higher than 15°.

For the upward irradiance E_u no direct relation corresponding to Eq. 9 is known, and consequently E_u was not interpolated for periods longer than one hour. It should be noted however that E_u is related to E_d by $E_u = RE_d$, where the irradiance reflectance R is dependent on h (Kirk, 1994). Therefore a possibility exists for estimating E_u at various solar altitudes.

Spectral irradiance was usually recorded at the standard depths 0, 1, 5, 10, 15, 25, 50, 75, and 100 m. Recordings at smaller depths intervals have revealed that in a semilogarithmic diagram linear interpolation between the standard depths can be applied with a high degree of accuracy.

3.5. *Irradiance from integrated radiance*

3.5.1. *Algorithms for downward irradiance*

Downward radiance was usually recorded at the zenith angles θ=0-10-20-25-30-40-50-60-70-80-90°, and at the azimuth directions towards the sun (ϕ=0) and away from the sun (ϕ=180°), denoted as $\theta+$ and $\theta-$, respectively. It is assumed that the azimuthal distribution of radiance follows the expression applied by Lundgren and Højerslev (1971):

$$L(\theta,\phi) = A\,\frac{\epsilon + 1}{\epsilon - \cos\phi} \tag{12}$$

where ϵ is termed the azimuthal ellipticity, defined as:

$$\epsilon = \frac{L(\theta+) - L(\theta-)}{L(\theta+) + L(\theta-)} \tag{13}$$

Eq. 12 gives, after some calculation, the azimuthal average of L as:

$$\overline{L(\theta)} = [L(\theta+)\;L(\theta-)]^{1/2} \tag{14}$$

Subsequently the bar above L will be omitted.

The integrals for downward irradiance E_d and downward scalar irradiance E_{0d} can be calculated by standard computer programs. However, the fairly simple integrals can more easily be computed on a PC by special algorithms.

The relation between L and θ can be described by functions similar to Eq. 12, but the analytical solutions will then become rather complicated. A linear variation with θ between the observed angles may be applied, but a better description is obtained by a second order polynomial between three subsequent angles:

$$L(\theta) \approx A + B\theta + C\theta^2 \tag{15}$$

However, the analytical solutions of the integrals become simpler if $\sin\theta$ or $\cos\theta$ is substituted for θ. In the angular range from 0° to about 45° $\sin\theta$ will be approximately proportional with θ, and the following function has been applied:

$$L(\theta) \approx A + B\sin\theta + C\sin^2\theta \tag{16}$$

With this form the contributions to E_d and E_{0d} from the interval θ_1-θ_3 become

$$\Delta E_d = 2\pi \,{}_{\theta_1}^{\theta_3}\!\left[\frac{A}{2}\sin^2\theta + \frac{B}{3}\sin^3\theta + \frac{C}{4}\sin^4\theta \right] \tag{17}$$

$$\Delta E_{od} = 2\pi \,{}_{\theta_1}^{\theta_3}\!\left[-A\cos\theta + B\left(\frac{\theta}{2} - \frac{\sin 2\theta}{4}\right) + C\left(-\cos\theta \frac{\cos^3\theta}{3}\right) \right] \tag{18}$$

From about 45° to 90° $\cos\theta$ will give a better proportionality with θ than $\sin\theta$, and the second order polynomial Eq. 15 is changed to

$$L(\theta) \approx A + B\cos\theta + C\cos^2\theta \tag{19}$$

and the contributions to the integrals become

$$\Delta E_d = 2\pi \,{}_{\theta_1}^{\theta_3}\!\left[-\frac{A}{2}\cos^2\theta - \frac{B}{3}\cos^3\theta - \frac{C}{4}\cos^4\theta \right] \tag{20}$$

$$\Delta E_{od} = 2\pi \,{}_{\theta_1}^{\theta_3}\!\left[-A\cos\theta - \frac{B}{2}\cos^2\theta - \frac{C}{3}\cos^3\theta \right] \tag{21}$$

Generally it can be demonstrated that when the second order polynomial

$$L(x) = A + B\,x + C\,x^2 \tag{22}$$

passes through the three points (x_1, L_1), (x_2, L_2), (x_3, L_3), where x is either $\sin\theta$ or $\cos\theta$, the three constants A, B, and C are determined by

$$A = -\frac{L_1}{N}x_2\,x_3\,(x_2 - x_3) - \frac{L_2}{N}x_3\,x_1\,(x_3 - x_1) - \frac{L_3}{N}x_1\,x_2\,(x_1 - x_2) \tag{23}$$

$$B = \frac{L_1}{N}(x_2^2 - x_3^2) + \frac{L_2}{N}(x_3^2 - x_1^2) + \frac{L_3}{N}(x_1^2 - x_2^2) \tag{24}$$

$$C = -\frac{L_1}{N}(x_2 - x_3) - \frac{L_2}{N}(x_3 - x_1) - \frac{L_3}{N}(x_1 - x_2) \tag{25}$$

where the denominator N is

$$N = (x_1^2 - x_3^2)(x_1 - x_2) - (x_1^2 - x_2^2)(x_1 - x_3) \tag{26}$$

The sine function Eq. 16 was applied for the zenith angle intervals 0-10-20°, 20-25-30°, and 30-40-50°, while the cosine function Eq. 19 was applied for the intervals 50-60-70° and 70-80-90°. Summation of the contributions from the different intervals results in

$$\begin{aligned} E_d = \Sigma \Delta E_d &= 0.00186L(0) + 0.24505L(10) + 0.17954L(20) \\ &+ 0.27945L(25) + 0.24293L(30) + 0.70920L(40) + 0.37147L(50) \\ &+ 0.62191L(60) + 0.24322L(70) + 0.24506L(80) + 0.00187L(90) \end{aligned} \tag{27}$$

$$\begin{aligned} E_{od} = \Sigma \Delta E_{od} &= 0.00114L(0) + 0.25108L(10) + 0.18954L(20) \\ &+ 0.30827L(25) + 0.27872L(30) + 0.93064L(40) + 0.56649L(50) \\ &+ 1.26267L(60) + 0.69354L(70) + 1.42775L(80) + 0.37926L(90) \end{aligned} \tag{28}$$

The algorithms can be tested by letting all radiances be equal to 1. Eqs. 23-24 then yield E_d=3.14156 and E_{0d}=6.28910, which is very close to the exact values π and 2π.

In those cases where $L(25)$ was not measured, its value in the algorithms above was substituted by the mean value of $L(20)$ and $L(30)$.

The radiance tubes would seldom point directly towards the sun. This means that close to the surface the calculated downward irradiances will usually be underestimated and represent the diffuse part rather than the total irradiance. From about 50 m and downwards the direct solar contibution to the irradiance has diminished, and the irradiances calculated from the radiance distribution will be less uncertain.

3.5.2. Algorithms for upward irradiance

Upward radiance was always recorded at the standard zenith angles θ=90-110-130-150-180°. Between the three first angles the variation of L with θ has been approximated with a second order polynomial of the cosine type (Eq. 19), and the contributions to the upward irradiance E_u and the upward scalar irradiance E_{0u} become

$$\Delta E_u = 2\pi \left[\frac{A}{2} \cos^2\theta + \frac{B}{3} \cos^3\theta + \frac{C}{4} \cos^4\theta \right]_{90°}^{130°} \tag{29}$$

$$\Delta E_{0d} = 2\pi \left[-A \cos\theta - \frac{B}{2} \cos^2\theta - \frac{C}{3} \cos^3\theta \right]_{\theta_1}^{\theta_3} \tag{30}$$

The angular range covered by the last three angles has been approximated by a function of the sine type (Eq. 16). The irradiance contributions now obtain the forms

$$\Delta E_u = 2\pi \left[-\frac{A}{2} \sin^2\theta - \frac{B}{3} \sin^3\theta - \frac{C}{4} \sin^4\theta \right]_{130°}^{180°} \tag{31}$$

$$\Delta E_{0u} = 2\pi \left[-A \cos\theta + B \left(\frac{\theta}{2} - \frac{\sin 2\theta}{4}\right) + C \left(-\cos\theta \frac{\cos^3\theta}{3}\right) \right]_{130°}^{180°} \tag{32}$$

The constants A, B, and C are also here determined by Eqs. 24-27. Summation of Eq. 29 and 29 and of Eq. 30 and 32 produces the following algorithms:

$$\begin{aligned} E_u = \Sigma \Delta E_u = {} & 0.02602 L(90) + 0.86897 L(110) + 0.74735 L(130) \\ & + 1.35550 L(150) + 0.14376 L(180) \end{aligned} \tag{33}$$

$$\begin{aligned} E_{0u} = \Sigma \Delta E_{0u} = {} & 0.75413 L(90) + 2.70380 L(110) + 1.11552 L(130) \\ & + 1.57007 L(150) + 0.13967 L(180) \end{aligned} \tag{34}$$

If all radiances are put equal to 1, the algorithms yield E_u=3.14160 and E_{0u}=6.28319. Both results agree excellently with the theoretical values π and 2π, respectively.

3.6. Calculation of apparent and inherent optical properties

3.6.1. Apparent optical properties

The mean cosines μ_d and μ_u for downward and upward radiance, respectively, are defined as:

$$\mu_d = \frac{E_d}{E_{od}} \tag{35}$$

$$\mu_u = \frac{E_u}{E_{ou}} \tag{36}$$

The irradiance ratio R is defined as:

$$R = \frac{E_u}{E_d} \tag{37}$$

The ratio has been calculated using interpolated observations of E_d at the times t_1 and t_3 versus E_u measured at the reference time t_2.

The distribution function Q is defined as

$$Q = \frac{E_u}{L_u} \tag{38}$$

where L_u is the radiance from nadir.

The point definition of the vertical attenuation coefficient $K(z)$ at the depth z is

$$K(z) = -\frac{1}{E(z)}\frac{dE(z)}{dz} \tag{39}$$

where E is any type of irradiance, for instance E_d, E_u, E_{od}, or E_{ou}. The practical definition of K is obtained by assuming a constant coefficient and integrating Eq. 39 from z_1 to z_2:

$$K = \frac{1}{z_2 - z_1}\ln\left(\frac{E(z_1)}{E(z_2)}\right) \tag{40}$$

In the last expression K generally represents the mean value of the coefficient in the depth range z_1-z_2.

Note that all four quantities defined in Eqs. 35-40 depend on the angular radiance distribution.

The radiance L_p recorded in a certain direction through a polaroid filter, will produce a signal which may depend on the orientation of the filter. If the signal is independent of the filter's orientation, the light is unpolarized. Otherwise the degree of polarization P is defined as

$$P = \frac{L_{p,\max} - L_{p,\min}}{L_{p,\max} + L_{p,\min}} \tag{41}$$

where $L_{p,max}$ and $L_{p,min}$ are the observed maximum and and minimum of the signal as the filter is rotated. In the sea the polarization is mainly linear, which means that the Stokes' parameter V is practically zero. The relation between P and the remaining three Stokes' parameters I, Q, and U then becomes

$$P = \frac{\sqrt{Q^2 + U^2}}{I} \tag{42}$$

The Stokes parameter Q, which should not be confused with the distribution function defined by Eq. 38, will not appear elsewhere in this paper.

3.6.2. *Inherent optical properties*

The Gershun equation for a horizontally stratified ocean states

$$a(z) = -\frac{1}{E_o(z)}\frac{d}{dz}[E_d(z)-E_u(z)] \tag{43}$$

where

$$E_o(z) = E_{od}(z)+E_{ou}(z) \tag{44}$$

is the total scalar irradiance. Eq. 43 also provides a point definition of the absorption coefficient a. The equation may be integrated by the assumption

$$E_o(z) = E_o(0)\ e^{-K_o z} \tag{45}$$

where K_o is the spatially averaged vertical attenuation coefficient for the scalar irradiance (McCormick and Højerslev, 1994). The result becomes

$$\frac{a}{K_o}\ [E_o(z_1)-E_o(z_2)] = [E_d(z_1)-E_u(z_1)-E_d(z_2)+E_u(z_2)] \tag{46}$$

where a approximates the mean value of $a(z)$ in the depth range z_1-z_2. According to Eq. 44 K_o may be expressed as

$$K_o = \frac{1}{z_2-z_1}\ \ln\left(\frac{E_o(z_1)}{E_o(z_2)}\right) \tag{47}$$

Thus the inherent optical property a may be determined from observations of the four irradiances E_d, E_u, E_{od}, and E_{ou} at two different depths, as derived from our radiance measurements.

In an earlier report from the Nordic Cruise (Højerslev, 1973) a was obtained from direct observations of E_d, E_u, and E_o. The present report contains no direct measurements of E_o, but the quantity may be estimated from Eqs. 35-36 and Eq. 45. If μ_d and μ_u are assumed constant with depth, Eq. 46 may by means of Eq. 39 be rewritten as

$$a \approx \mu_d\, K_o\ \frac{E_d(z_1)[1-R(z_1)]-E_d(z_2)[1-R(z_2)]}{E_d(z_1)[1+(\mu_d/\mu_u)R(z_1)]-E_d(z_2)[1+(\mu_d/\mu_u)R(z_2)]} \tag{48}$$

where

$$K_o \approx \frac{1}{z_2-z_1}\ \ln\left(\frac{E_d(z_1)}{E_d(z_2)}\ \frac{1+(\mu_d/\mu_u)R(z_1)}{1+(\mu_d/\mu_u)R(z_2)}\right) \tag{49}$$

According to Tables 8.2.1-8.2.3 the standard deviations of μ_d, μ_u, and μ_d/μ_u are in the range 6-7%. The errors introduced by applying the average values $\mu_d \approx 0.75$ and $\mu_d/\mu_u \approx 1.9$ in Eqs. 47-48 will then be about 10%. The equations become

$$a \approx 0.75\ K_o \frac{E_d(z_1)[1-R(z_1)]-E_d(z_2)[1-R(z_2)]}{E_d(z_1)[1+1.9R(z_1)]-E_d(z_2)[1+1.9R(z_2)]} \tag{50}$$

$$K_o \approx \frac{1}{z_2-z_1} \ln\left(\frac{E_d(z_1)}{E_d(z_2)}\ \frac{1+1.9R(z_1)}{1+1.9R(z_2)}\right) \tag{51}$$

Here a is only a function of $E_d(z)$ and $R(z)$.

4. Results

Spectral irradiance, radiance, polarization and related quantities are presented in the tables found in the tables of Parts 2-3. A few examples are presented in Figs. 6-8.

The irradiance reflectance varied by a factor of 10 in the spectral mode and around a factor of 4 with depth (Tables 7.2.1-7). The change of reflectance with depth sometimes caused the ratio a/K_u to exceed unity in the red part of the spectrum (Tables 7.3.2-3).

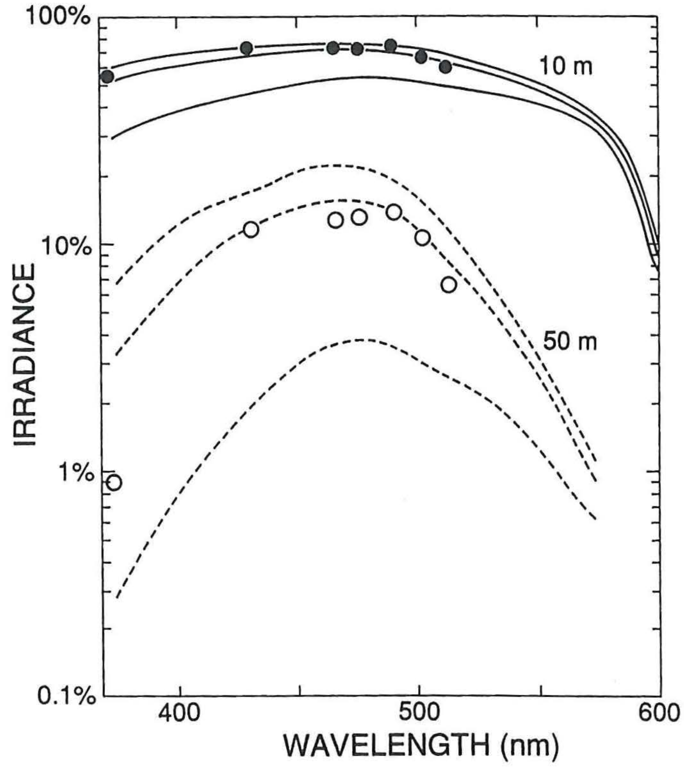
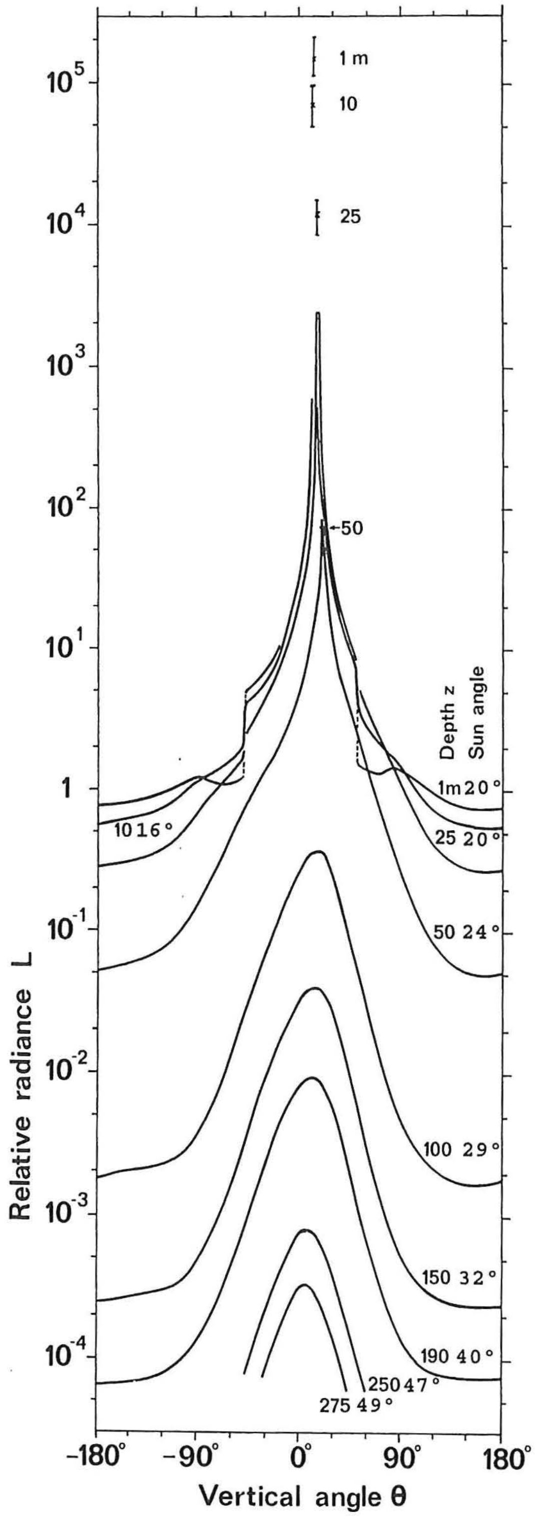


Fig. 6. Spectral irradiance observed at Station E2, July 6, 1971, h=68°, at the depths 10 m (●) and 50 m (○), as compared with Jerlov's (1976) optical ocean water types IA, IB, and II at 10 m (solid lines) and at 50 m (dashed lines). The spectral irradiances measured at both 10 m and 50 m suggest that the water belongs to type IB except in the ultraviolet part of the spectrum.

Fig. 7. Angular radiance distribution L(θ) in the solar plane at Station D2, July 8, 1971, λ=474 nm, for different depths and solar zenith angles in air (a different drawing has been presented by Jerlov (1976)). The distinct and high radiances in the near surface measurements in the direction of the refracted sun rays should be noted. At great depths these peak radiances vanish and the maximum radiance is observed around zenith. The change of the angular distribution with depth is also clearly depicted as a trend towards increasing symmetry around the vertical axis.



The irradiance measurements revealed that all the Mediterranean surface waters between 0 and 10 meters belong to the water types *IA*, *IB* and *II* according to Jerlov's optical water classification scheme (1976). The irradiance measurements at 50 m deviated from IA, IB and II (Jerlov, 1978) in some cases. In the ultraviolet part of the spectrum the optical classification scheme failed in general (Fig. 6).

Mean values of the ratio K_d/K_u in the upper 10 meters increased from 0.7 in the UV to 2.1 in the red part of the spectrum (Table 7.4.1).

Irradiance calculated from the radiance data sets compared favourably with directly measured irradiance, except for the near-surface measurements where ship shadows and sun glints are problematic. It was estimated in Chapter 2.4 that self-shading effects from the instrument in general were small for the upward radiance. An example of angular radiance distributions is presented in Figs. 7-8.

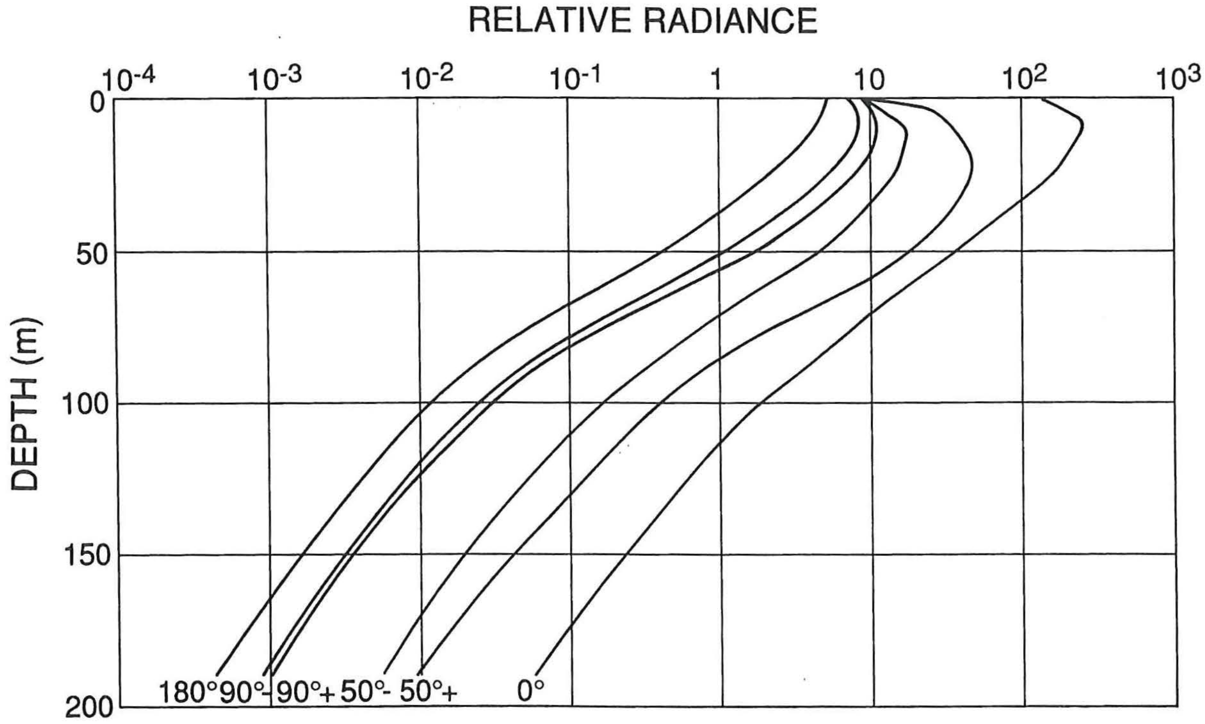


Fig.8. Vertical profiles of L(θ) at Station D2, July 8, 1971, λ=474 nm, based on Fig. 7. The selected radiances as a function of depth display 4 distinct features which are the case in general (see also Table 8.1.5): (1) The radiance curves tend to be parallel at great depths which is predicted by the equation of radiative transfer in the asymptotic regime. (2) The upward radiances are always smaller than the downward radiances and the radiances within the zenith angle range θ=150°-180° represent the minimum value throughout the whole water column. Moreover the mentioned radiances display the minimum vertical attenuation. (3) Some of the downward radiances increase with depth in the surface layers leading to a subsurface radiance maximum. (4) The vertical attenuation measured during the cruise varies considerably with depth. The maximum attenuation is caused by a subsurface phytoplankton maximum.

Various distribution functions have been calculated (Tables 8.2.1-3). The average cosine μ varied around 0.8 (±10%), the average cosine μ_u for the upward radiance around 0.4 (±10%), and the ratio Q of the upward irradiance and the nadir radiance was about 4 (±20%).

The ratio of maximum and minimum downward radiances, respectively, varied by up to 6 orders of magnitude in surface waters at clear weather conditions and high solar altitudes. At great depths this variation dropped to 2-3 orders of magnitude.

In contrast to this the corresponding ratio for the upward radiances varied much less than one order of magnitude at all depths. The water-leaving (upward) radiances were almost constant in the anti-sun direction at zenith angles in the interval 140-180°.

The polarization was found to be almost linear. The degree of polarization varied between 0 and 50% which is somewhat lower than earlier reported in the literature for clear water masses.

In a report by Højerslev and Aas (1997) some further results from the second optical cruise leg are presented and discussed.

5. Acknowledgements

The Nordic cruise to the Mediterranean was made possible through grants from the Danish Scientific Council and the Norwegian Council for Natural Science and the Humanities. The Nordic Collegium for Physical Oceanography has on several occasions supported this project. We are also due thanks to Jørgen Holck and Niels Berg Olsen for their contributions to the field work and the analysis of the recordings.

6. References

Aas, E., 1969. On submarine irradiance measurements. Rep. Dept. Phys. Oceanogr., Univ. Copenhagen, **6**, 47 pp.

Aas, E. and Korsbø, B., 1997. Self-shading effect by radiance meters on upward radiance observed in coastal waters. *Limnol. Oceanogr.*, **42** (in print).

Gordon, H. R., and Ding, K., 1992. Self-shading of in-water optical instruments. *Limnol. Oceanogr.*, **37**: 491-500.

Højerslev, N. K., 1973. Inherent and apparent optical properties of the Western Mediterranean and the Hardangerfjord. Rep. Dept. Phys. Oceanogr., Univ. Copenhagen, **21**, 72 pp.

Højerslev, N. K., 1974. Daylight measurements for photosynthetic studies in the Western Mediterranean. Rep. Dept. Phys. Oceanogr., Univ. Copenhagen, **26**, 38 pp.

Højerslev, N. K. and Jerlov, N. G., 1977. The use of the colour index for determining quanta irradiance in the sea. Rep. Dept. Phys. Oceanogr., Univ. Copenhagen, **35**, 12 pp.

Høkedal, J. and Aas, E., 1994. Calibration of two single-channel instruments for UV-B and blue irradiance. Rep. Dept. Geophys., Univ. Oslo, **88**, 17 pp.

Højerslev, N. K. and Aas, E., 1997. Spectral irradiance, radiance and polarization in blue Western Mediterranean waters. In *Ocean Optics XIII, 22-25 October 1996, Halifax, Nova Scotia, Canada*, eds. S. G. Ackleson and R. Frouin. SPIE, **2963**: 138-147.

Jerlov, N. G., 1965. The evolution of the instrumental technique in underwater optics. In *Progress in Oceanography*, **3**, ed. M. Sears, pp. 149-157. Pergamon, New York.

Jerlov, N. G., 1974a. Significant relationships between optical properties of the sea. In *Optical Aspects of Oceanography*, eds. N. G. Jerlov and E. Steemann Nielsen, pp. 77-94. Academic, London.

Jerlov, N. G., 1974b. A simple method for measuring quanta irradiance in the ocean. Rep. Dept. Phys. Oceanogr., Univ. Copenhagen, **24**, 10 pp.
Jerlov, N.G., 1976. *Marine Optics*. Elsevier, Amsterdam, 231 pp.

Jerlov, N. G., 1978. The optical classification of se water in the euphotic zone. Rep. Dept. Phys. Oceanogr., Univ. Copenhagen, **36**, 46 pp.

Jerlov, N. G. and Nygård, K. 1969. A quanta and energy meter for photosynthetic studies. Rep. Dept. Phys. Oceanogr., Univ. Copenhagen, **10**, 29 pp.

Kirk, J. T. O., 1994. The relationship between the inherent and the apparent optical properties of surface waters and its dependence on the shape of the volume scattering function. In *Ocean Optics*, eds. R. W. Spinrad, K. L. Carder and M. J. Perry, pp. 40-58. Oxford Univ. Press, Oxford.

Kullenberg, G. and Berg Olsen, N., 1972. A comparison between observed and computed light scattering functions - II. Rep. Dept. Phys. Oceanogr., Univ. Copenhagen, **19**, 27 pp.

Lundgren, B., 1971. On the polarization of the daylight in the sea. Rep. Dept. Phys. Oceanogr., Univ. Copenhagen, **17**, 34 pp.

Lundgren, B. and Højerslev, N. K., 1971. Daylight measurements in the Sargasso Sea. Results from the "Dana" Expedition January-April 1966. Rep. Dept. Phys. Oceanogr., Univ. Copenhagen, **14**, 44 pp.

McCormick, N. J. and Højerslev, N. K., 1994. Ocean optics attenuation coefficients: local versus spatially averaged. *Appl. Opt.*, 33: 7067-7069.

Mosby, H., 1952. Wire-angle in oceanography. Univ. Bergen, Årbok, Naturvidenskapelig rekke, Nr. 2, 26 pp.

Mosby, H., 1955. Note on wire-angle in oceanography. *J. Mar. Res.*, **14**: 259-260.

Smith, R. C., 1969. An underwater spectral irradiance collector. *J. Mar. Res.*, 27: 341-351.

Smith, R. C., 1974. Structure of solar radiation in the upper layers of the sea. In *Optical Aspects of Oceanography*, eds. N. G. Jerlov and E. Steemann Nielsen, pp. 95-119. Academic, London.

PART 2. TABLES FOR IRRADIANCE AND QUANTITIES DERIVED FROM IRRADIANCE

E_d = downward irradiance
E_u = upward irradiance
h = solar altitude
t = solar time (h_{max} at $t=1200$)
R = irradiance ratio E_u/E_d
z_1-z_2 = depth range (m)
a = absorption coefficient (m^{-1})
K_o = vertical attenuation coefficient of scalar irradiance (m^{-1})
K_d = vertical attenuation coefficient of downward irradiance (m^{-1})
K_u = vertical attenuation coefficient of upward irradiance (m^{-1})
λ = wavelength (nm)

Bold numbers to the right of the headings *Depth* and z_1-z_2 are wavelengths in nm. Depths are in m. The lines with numbers in parentheses in Tables 7.1.1-7.1.25 present the surface irradiances with recorded signals in mV.

Table 7.1.1. E_d **at Station J1, June 24, 1971,** t**=0910,** h**=51°**

	E_d (%)							
Depth	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
(0)	(95)	(99)	(160)	(150)	(90)	(94)	(100)	(100)
0	100	100	100	100	100	100	100	100
1	94.7	95.2	98.1	97.3	94.4	95.7	95.0	95.0
5	80.0	83.8	84.4	86.0	85.5	81.8	79.1	77.8
10	65.3	70.6	72.5	72.0	72.1	69.2	64.6	57.5
25	35.6	42.4	44.6	44.0	43.6	39.4	29.4	21.1
50	12.5	18.3	20.4	19.5	20.4	14.8	9.34	5.10
75	1.37	3.08	3.54	3.99	4.19	3.00	1.62	.716
100	.173	.481	.725	.787	.884	.626	.302	.107

Table 7.1.2. E_u **at Station J1, June 24, 1971,** t**=1045,** h**=68°**

	E_u (%)							
Depth	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
(0)	(4.8)	(5.5)	(9.0)	(7.3)	(3.8)	(3.0)	(2.2)	(1.6)
0	100	100	100	100	100	100	100	100
1	95.8	93.6	95.6	95.9	92.4	93.3	96.8	90.0
5	78.1	80.5	78.6	80.8	79.7	78.0	77.3	72.5
10	62.5	64.5	67.3	65.8	65.8	62.3	60.0	55.0
25	31.3	32.9	35.2	35.3	36.1	31.5	28.1	22.4
50	6.96	9.33	10.4	11.5	12.4	11.5	9.05	6.50
75	.765	1.53	2.06	2.25	2.68	2.39	1.77	1.11
100	.123	.298	.426	.501	.616	.550	.352	.184

Table 7.1.3. E_d **at Station J1, June 24, 1971,** t**=1215,** h**=74°**

	E_d (%)							
Depth	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
(0)	(142)	(180)	(310)	(280)	(160)	(165)	(180)	(193)
0	100	100	100	100	100	100	100	100
1	97.2	98.9	96.8	95.4	96.9	97.0	96.1	92.7
5	85.9	87.8	86.5	83.9	85.6	83.6	80.0	68.4
10	74.6	76.1	72.9	69.6	74.4	70.9	63.9	51.8
25	48.5	49.2	51.9	47.5	48.9	43.7	32.9	23.0
50	12.3	14.4	17.6	17.2	17.1	13.1	8.22	4.47
75	1.97	3.18	3.94	4.07	4.43	3.38	1.84	.792
100	.234	.527	.710	.7572	.888	.661	.318	.112

Table 7.1.4. E_d at Station J1, June 25, 1971, t=1500, h=50°

	E_d (%)							
Depth	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
(0)	(16.5)	(148)	(120)	(29.5)	(82.5)	(62.6)	(40.0)	(25.3)
0	100	100	100	100	100	100	100	100
1	90.9	97.3	93.3	92.2	65.5	62.6	68.8	59.3
5	65.5	70.3	65.4	59.7	21.1	14.1	13.0	6.68
10	46.1	51.4	44.3	34.2	5.41	2.09	1.63	.371
15	34.5	39.5	31.8	21.3	2.01	.463	.323	.0403
25	16.4	19.8	13.7	7.05	.245	-	-	-
50	1.21	3.31	1.97	.590	-	-	-	-
75	.0410	.509	.253	.0505	-	-	-	-
100	.00152	.0608	.0277	.00373	-	-	-	-

Table 7.1.5. E_u at Station J1, June 25, 1971, t=1625, h=33°

	E_u (%)							
Depth	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
(0)	(.265)	(.779)	(.476)	(.0723)	(.0493)	(.0228)	(.0146)	(.00675)
0	100	100	100	100	100	100	100	100
1	94.7	95.3	93.7	92.4	82.8	73.2	68.1	64.9
5	77.0	78.4	72.3	63.2	38.9	21.1	14.7	11.6
10	57.7	64.4	57.4	44.7	20.5	-	-	-
15	41.5	52.5	43.9	32.4	-	-	-	-
20	30.6	42.1	35.5	23.7	-	-	-	-
25	20.4	32.7	26.9	16.6	-	-	-	-

Table 7.1.6. E_d at Station J1, June 26, 1971, t=0600, h=15°

	E_d (%)							
Depth	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
(0)	(3.00)	(28.5)	(20.6)	(4.70)	(9.80)	(7.10)	(5.00)	(3.10)
0	100	100	100	100	100	100	100	100
1	91.3	93.0	92.2	90.4	76.1	69.4	67.0	53.5
5	63.3	69.5	67.0	60.6	25.5	16.2	13.6	4.42
10	44.3	45.6	42.2	32.6	6.12	2.51	1.50	.360
15	29.7	30.4	26.5	17.7	1.78	.366	.224	-
25	13.0	14.4	11.2	5.23	-	-	-	-
50	.853	2.02	1.26	.340	-	-	-	-
75	.0253	.298	.158	.0281	-	-	-	-
100	.0008	.0346	.0153	.00221	-	-	-	-

Table 7.1.7. E_u at Station J1, June 26, 1971, t=0820, h=42°

	E_u (%)							
Depth	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
(0)	(.630)	(1.53)	(.950)	(.150)	(.070)	(.033)	(.020)	(.0065)
0	100	100	100	100	100	100	100	100
1	87.3	94.8	92.6	92.0	89.3	77.0	73.0	73.8
5	50.6	70.6	64.1	57.1	48.3	27.6	25.0	29.4
10	31.7	48.9	41.1	30.4	19.4	10.1	-	-
15	17.8	32.1	26.2	17.7	-	-	-	-
25	5.25	15.0	11.5	6.53	-	-	-	-
50	.227	2.75	-	-	-	-	-	-
75	.00667	.407	-	-	-	-	-	-
100	-	.0654	-	-	-	-	-	-

Table 7.1.8. E_d at Station J1, June 26, 1971, t=0930, h=55°

	E_d (%)							
Depth	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
(0)	(18.6)	(176)	(123)	(35.8)	(79.9)	(60.9)	(49.7)	(18.7)
0	100	100	100	100	100	100	100	100
1	93.5	92.6	93.5	90.2	76.8	67.3	64.8	61.0
5	71.5	67.6	69.5	60.1	26.8	13.9	11.3	8.61
10	51.3	51.1	48.9	36.0	7.48	2.53	1.67	.461
15	36.8	38.7	34.2	21.6	2.09	.461	.247	.0247
25	18.9	22.2	16.8	7.79	.163	.0154	.00541	.000070
50	.892	3.32	2.33	.584	-	-	-	-
75	.0316	.468	.290	.0479	-	-	-	-
100	.00112	.0659	.0361	.00388	-	-	-	-

Table 7.1.9. E_d at Station J2, June 28, 1971, t=0510, h=6°

	E_d (%)							
Depth	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
(0)	(.90)	(8.0)	(6.0)	(1.5)	(3.6)	(2.8)	(2.5)	(1.5)
0	100	100	100	100	100	100	100	100
0.5	89.3	89.1	91.2	91.3	85.3	83.2	72.8	76.7
5	60.7	69.3	62.2	52.4	20.1	13.0	8.44	3.37
10	41.6	43.0	39.0	26.8	4.56	1.58	-	-
15	25.6	26.0	21.2	11.8	.961	.245	-	-
25	11.1	12.4	8.65	3.51	-	-	-	-
50	.661	1.86	1.13	.275	-	-	-	-
75	.0144	.194	.107	.0173	-	-	-	-
100	-	.0276	.0132	-	-	-	-	-

Table 7.1.10. E_d at Station J2, June 28, 1971, t=0700, h=25°

	E_d (%)							
Depth	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
(0)	(5.5)	(55)	(38)	(10)	(27)	(20)	(10)	(8)
0	100	100	100	100	100	100	100	100
1	92.7	94.5	94.7	93.0	74.1	70.0	58.9	54.9
5	71.5	72.0	68.4	62.6	23.9	16.0	11.0	3.38
10	48.4	45.8	46.8	36.6	5.30	2.13	-	-
15	34.0	32.4	28.7	19.4	1.30	-	-	-
20	25.3	22.2	20.1	10.4	-	-	-	-
25	15.7	15.8	13.2	6.33	-	-	-	-
50	.576	1.98	1.38	.381	-	-	-	-
75	-	.181	.109	.0229	-	-	-	-
100	-	.0285	.0145	.0014	-	-	-	-

Table 7.1.11. E_u at Station J2, June 28. 1971, t=0830, h=42°

	E_u (%)							
Depth	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
(0)	(.317)	(.931)	(.540)	(.0796)	(.0556)	(.0242)	(.0145)	(.00497)
0	100	100	100	100	100	100	100	100
0.5	96.5	96.7	96.3	96.0	90.5	87.2	85.5	87.3
1	93.4	93.4	92.6	92.1	81.8	76.0	73.1	76.3
5	71.0	71.5	68.5	66.3	36.7	25.0	-	-
10	47.9	53.2	48.1	43.0	-	-	-	-
15	25.9	38.5	33.3	26.9	-	-	-	-
20	13.2	27.1	24.1	18.1	-	-	-	-
25	6.03	19.3	16.7	10.9	-	-	-	-
50	.240	4.20	3.37	-	-	-	-	-
75	.00726	.352	.320	-	-	-	-	-
100	-	.0597	.0517	-	-	-	-	-

Table 7.1.12. E_d at Station J2, June 28, 1971, t=0950, h=57°

	E_d (%)							
Depth	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
(0)	(15.5)	(140)	(113)	(36)	(70)	(53)	(40)	(33)
0	100	100	100	100	100	100	100	100
1	92.9	96.4	92.9	88.9	76.6	70.2	66.0	45.5
5	76.1	77.1	67.1	58.9	26.1	16.8	12.1	2.34
10	55.0	57.5	48.5	31.9	7.10	2.91	1.60	-
15	40.1	45.1	31.9	18.2	2.40	.513	.150	-
20	25.4	30.0	22.0	10.5	.806	.0757	-	-
25	15.3	20.8	15.0	6.03	.307	-	-	-
50	.502	2.91	1.73	.419	-	-	-	-
75	.0162	.336	.179	.0286	-	-	-	-
100	.00094	.0497	.0227	.00222	-	-	-	-

Table 7.1.13. E_d at Station J2, June 28, 1971, t=1415, h=60°

	E_d (%)							
Depth	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
(0)	(74)	(86)	(145)	(120)	(73)	(76)	(85)	(80)
0	100	100	100	100	100	100	100	100
1	94.6	97.7	95.9	96.7	94.2	94.7	95.3	93.8
5	85.1	86.7	89.0	89.2	81.4	85.5	80.0	77.5
10	74.1	75.6	77.9	77.2	68.5	75.0	66.2	60.0
15	62.2	65.1	69.0	68.6	57.5	66.4	51.9	47.5
20	50.8	55.1	59.3	57.5	47.9	50.7	39.1	36.3
25	40.7	43.1	51.3	49.8	41.2	41.2	29.4	26.9
50	7.68	11.2	13.0	13.5	13.2	11.9	6.75	4.25
75	.731	1.45	1.86	2.08	2.30	2.09	1.07	.578
100	.0697	.188	.268	.321	.404	.366	.169	.0785

Table 7.1.14. E_u at Station J2, June 28, 1971, t=1520, h=47°

	E_u (%)							
Depth	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
(0)	(2.22)	(2.32)	(3.81)	(2.97)	(1.55)	(1.40)	(1.02)	(.744)
0	100	100	100	100	100	100	100	100
1	96.4	96.6	96.3	95.6	96.8	96.4	95.3	94.4
5	83.3	84.5	82.9	84.2	84.5	83.6	79.2	74.6
10	63.1	74.1	69.6	70.7	71.0	73.6	69.1	62.4
15	49.5	57.3	58.0	60.3	61.9	59.1	54.0	47.2
20	35.9	45.3	44.9	45.5	48.2	46.6	41.2	33.7
25	28.7	36.9	39.6	40.7	38.7	39.2	35.1	28.2
50	2.55	4.66	5.59	6.33	7.61	7.36	5.70	3.99
75	.132	.345	.486	.562	.813	.850	.614	.374
100	.0347	.117	.162	.205	.268	.232	.131	.0613

Table 7.1.15. E_d at Station J2, June 28, 1971, t=1620, h=35°

	E_d (%)							
Depth	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
(0)	(45)	(48)	(91)	(76)	(44)	(48)	(51)	(53)
0	100	100	100	100	100	100	100	100
1	95.6	99.4	97.1	93.9	94.8	97.3	95.5	92.6
5	78.9	83.3	87.0	84.2	84.1	83.5	80.2	67.9
10	66.0	72.9	74.6	69.7	68.2	69.6	57.5	50.9
15	52.9	64.8	61.6	56.2	55.2	54.2	41.8	34.7
20	44.4	54.4	53.2	49.6	47.0	43.8	33.1	26.6
25	36.4	44.8	42.6	40.8	36.4	35.6	24.7	18.0
50	5.78	9.42	9.49	10.0	10.4	8.60	4.88	2.75
75	.333	.831	.989	1.07	1.26	1.14	.561	.264
100	.0622	.181	.231	.264	.327	.265	.119	.0432

Table 7.1.16. E_u at Station J2, June 28, 1971, t=1735, h=21°

	E_u (%)							
Depth	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
(0)	(1.15)	(1.35)	(2.02)	(1.70)	(.95)	(.80)	(.57)	(.38)
0	100	100	100	100	100	100	100	100
1	95.7	96.3	99.0	95.3	94.7	95.0	96.5	97.1
5	78.3	76.3	82.7	81.8	82.9	80.0	81.1	78.9
10	56.5	59.3	63.4	64.7	64.0	63.5	60.7	58.4
15	42.5	45.7	53.5	52.1	52.9	53.0	48.6	44.5
20	33.5	35.6	45.1	41.8	43.8	40.0	38.8	34.2
25	21.1	24.6	36.3	32.8	28.1	28.8	27.9	25.8
50	2.16	3.37	4.61	4.96	5.55	5.89	4.18	3.11
75	.133	.292	.421	.460	.518	.515	.437	.268
100	.0365	.0904	.144	.162	.189	.169	.0895	.0476

Table 7.1.17. E_d at Station J2, June 28, 1971, t=1830, h=10°

	E_d (%)							
Depth	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
(0)	(8.0)	(9.0)	(16.5)	(13)	(7.6)	(9.0)	(9.0)	(9.5)
0	100	100	100	100	100	100	100	100
1	97.0	95.6	98.2	97.7	98.7	95.6	99.1	96.9
5	79.6	84.4	83.0	85.4	85.8	83.3	76.6	68.8
10	65.8	73.3	72.7	72.9	73.4	66.6	57.0	49.1
15	56.5	65.7	63.6	65.7	63.8	56.6	45.2	36.1
20	49.3	56.6	53.6	55.2	53.8	46.0	33.8	25.6
25	39.4	46.1	44.3	46.8	46.1	35.8	26.0	17.3
50	6.55	9.54	9.88	10.7	10.6	7.43	4.27	2.08
75	.419	.909	1.06	1.24	1.34	1.04	.536	.225
100	.0935	.222	.273	.329	.388	.279	.134	.0503

Table 7.1.18. E_d at Station E2, July 6, 1971, t=0732, h=30°

	E_d (%)							
Depth	**371**	**454**	**465**	**474**	**489**	**502**	**513**	**630**
(0)	(7.4)	(56.5)	(102)	(93)	(54)	(53)	(54)	(20)
0	100	100	100	100	100	100	100	100
1	93.1	95.6	96.6	96.8	96.1	95.8	94.4	78.5
5	67.7	79.8	83.3	82.5	80.4	77.4	78.3	12.5
10	47.8	67.3	68.9	67.4	69.4	61.3	61.7	2.39
15	30.5	54.3	57.1	54.5	56.7	50.2	45.9	.419
20	20.7	44.8	48.8	44.9	46.1	40.0	33.7	-
25	14.1	36.8	41.8	37.0	37.6	31.9	24.6	-
50	-	8.35	9.62	9.74	10.5	8.36	5.33	-
75	-	1.23	1.72	1.82	2.00	1.52	.781	-
100	-	.152	.204	.252	.317	.236	.120	-

Table 7.1.19. E_u at Station E2, July 6, 1971, t=0900, h=47°

	E_u (%)							
Depth	**371**	**454**	**465**	**474**	**489**	**502**	**513**	**630**
(0)	(.40)	(3.2)	(5.3)	(4.7)	(2.4)	(1.8)	(1.45)	(.035)
0	100	100	100	100	100	100	100	100
1	93.5	95.0	95.1	95.7	95.4	96.7	93.8	76.6
5	69.8	80.6	80.4	80.6	82.5	82.8	77.2	22.9
10	47.8	63.1	65.1	65.7	65.8	63.9	58.3	-
15	31.0	51.9	53.0	54.3	56.7	55.2	45.4	-
20	14.4	36.9	39.1	40.4	41.0	40.9	33.2	-
25	6.70	26.2	28.7	30.0	29.7	30.3	24.3	-
50	.215	5.44	5.98	6.57	7.75	7.33	5.61	-
75	-	.738	.964	1.19	1.59	1.59	1.00	-
100	-	.169	.234	.247	.377	.356	.219	-

Table 7.1.20. E_d at Station E2, July 6, 1971, t=1100, h=69°

	E_d (%)							
Depth	**371**	**454**	**465**	**474**	**489**	**502**	**513**	**630**
(0)	(20.5)	(133)	(256)	(216)	(122)	(127)	(147)	(70)
0	100	100	100	100	100	100	100	100
1	93.2	97.0	96.9	96.8	97.5	96.1	95.2	71.7
20	28.0	51.2	51.9	52.3	85.9	46.5	37.5	-
25	20.7	44.3	43.8	46.8	48.0	38.6	29.9	-
50	.893	11.7	12.5	13.0	14.2	10.7	6.67	-
75	-	1.76	1.98	2.34	2.95	2.26	1.30	-
100	-	.232	.319	.378	.511	.384	.193	-

Table 7.1.21. E_u at Station E2, July 6, 1971, t=1135, h=73°

	E_u (%)							
Depth	**371**	**454**	**465**	**474**	**489**	**502**	**513**	**630**
(0)	(.66)	(4.2)	(6.9)	(5.8)	(3.0)	(2.4)	(1.92)	(.039)
0	100	100	100	100	100	100	100	100
1	92.1	95.0	96.4	96.6	96.0	95.0	95.8	77.9
20	20.2	44.0	45.9	51.6	49.3	45.4	41.0	.641
50	-	4.48	5.64	6.09	7.37	7.00	5.73	-
100	-	.167	.245	.309	.423	.375	.248	-

Table 7.1.22. E_d at Station A2, July 12, 1971, t=1345, h=68°

	E_d (%)							
Depth	**371**	**454**	**465**	**474**	**489**	**502**	**513**	**630**
(0)	(21)	(150)	(270)	(240)	(150)	(145)	(165)	(110)
0	100	100	100	100	100	100	100	100
1	87.6	88.0	91.1	89.6	89.3	89.0	89.1	64.5
5	44.0	58.4	63.0	66.7	61.3	63.7	63.6	10.9
10	18.5	31.0	34.1	32.7	36.4	37.0	36.1	1.86
15	6.19	13.9	15.3	15.4	19.2	19.7	19.2	.319
25	.667	2.49	3.04	3.26	4.37	4.86	4.59	.0344
50	-	.268	.363	.433	.634	.717	.576	-
75	-	.0303	.0496	.0625	.100	.108	.0758	-
100	-	.00389	.00637	.00925	.0156	.0170	.00994	-

Table 7.1.23. E_u at Station A2, July 12, 1971, t=1440, h=57°

	E_u (%)							
Depth	**371**	**454**	**465**	**474**	**489**	**502**	**513**	**630**
(0)	(.24)	(1.82)	(3.3)	(3.0)	(1.82)	(1.72)	(1.73)	(.0724)
0	100	100	100	100	100	100	100	100
5	44.6	57.1	57.9	61.3	65.9	69.2	70.5	26.0
10	17.3	27.7	28.0	30.4	35.9	39.0	40.4	8.88
15	5.04	9.01	10.4	11.6	14.7	17.0	17.9	3.54
25	.542	1.83	2.14	2.53	3.65	4.36	4.41	.594
50	-	.256	.327	.407	.648	.762	.618	-
75	-	.0390	.0509	.0697	.132	.157	.115	-
100	-	.0099	.0142	.0217	.0385	.0040	.0231	-

Table 7.1.24. E_d at Station A2, July 12, 1971, t=1510, h=52°

	E_d (%)							
Depth	**371**	**454**	**465**	**474**	**489**	**502**	**513**	**630**
(0)	(15.7)	(114)	(212)	(184)	(110)	(104)	(118)	(49.2)
0	100	100	100	100	100	100	100	100
50	-	.391	.509	.641	1.00	1.15	.941	-
100		.0034	.0053	.0080	.0154	.0177	.0107	-

Table 7.1.25. E_d at Station A2, July 13, 1971, t=1440, h=58°

	E_d (%)						
Depth	**429**	**533**	**548**	**574**	**601**	**649**	**693**
(0)	(114)	(208)	(161)	(41)	(119)	(56)	(39)
0	100	100	100	100	100	100	100
1	93.0	90.9	89.4	85.6	62.2	66.8	54.6
2	86.6	82.7	80.1	73.4	-	-	-
5	64.6	59.6	55.9	47.6	-	-	-
10	51.3	43.7	41.1	30.0	-	-	-
15	41.4	33.7	29.6	21.1	-	-	-
25	21.0	15.3	12.4	6.63	-	-	-
50	.745	1.14	.770	.273	-	-	-
75	.0586	.136	.0820	.0178	-	-	-
100	.0088	.0208	.0107	.00220	-	-	-

Table 7.2.1. R at Station J1, June 24, 1971, $t=1045$, $h=68°$

	R (%)							
Depth	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
0	3.75	3.69	3.60	3.19	2.84	2.16	1.47	1.03
1	3.74	3.55	3.54	3.18	2.74	2.09	1.49	.986
5	3.50	3.46	3.30	2.76	2.66	2.03	1.43	1.13
10	3.33	3.23	3.33	2.96	2.55	1.92	1.37	1.04
25	2.76	2.62	2.60	2.46	2.20	1.63	1.31	1.04
50	2.10	2.14	1.99	2.01	1.91	1.79	1.53	1.41
75	1.70	1.80	1.97	1.77	1.76	1.61	1.49	1.50
100	2.25	2.17	2.14	2.08	1.97	1.84	1.66	1.72

Table 7.2.2. R at Station J1, June 26, 1971, $t=0820$, $h=42°$

	R (%)							
Depth	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
0	4.81	1.22	1.08	.628	.133	.0833	.0639	.0489
1	4.51	1.26	1.08	.639	.155	.0944	.0716	.0613
5	3.51	1.27	1.01	.595	.243	.160	.135	.194
10	3.09	1.21	.947	.542	.361	.334	-	-
15	2.45	1.09	.886	.538	-	-	-	-
25	1.46	.927	.820	.569	-	-	-	-
50	1.23	1.14	-	-	-	-	-	-
75	1.07	1.19	-	-	-	-	-	-
100	-	1.41	-	-	-	-	-	-

Table 7.2.3. R at Station J2, June 28, 1971, $t=0830$, $h=42°$

	R (%)							
Depth	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
0	2.88	.895	.691	.346	.108	.0627	.0592	.0249
0.5	2.89	.882	.666	.349	.113	.0653	.0636	.0310
1	2.90	.876	.683	.352	.117	.0679	.0679	.0388
5	2.77	.858	.699	.380	.158	.0956	-	-
10	2.66	.917	.707	.441	-	-	-	-
15	2.00	.882	.756	.499	-	-	-	-
20	1.51	.923	.783	.598	-	-	-	-
25	1.12	.942	.811	.616	-	-	-	-
50	1.31	1.52	1.48	-	-	-	-	-
75	-	1.21	1.49	-	-	-	-	-
100	-	1.34	1.87	-	-	-	-	-

Table 7.2.4. *R* at Station J2, June 28, 1971, t=1520, h=47°

	R (%)							
Depth	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
0	3.63	3.41	3.12	2.94	2.58	2.18	1.46	1.07
1	3.68	3.35	3.11	2.94	2.64	2.19	1.46	1.09
5	3.70	3.39	2.95	2.85	2.64	2.16	1.44	1.11
10	3.28	3.41	2.97	2.94	2.68	2.23	1.64	1.22
15	3.14	3.02	2.79	2.85	2.84	2.16	1.70	1.25
20	2.75	2.82	2.50	2.50	2.62	2.17	1.67	1.17
25	2.71	2.86	2.66	2.66	2.59	2.24	1.90	1.38
50	1.39	1.54	1.58	1.59	1.68	1.59	1.45	1.26
75	.924	1.04	1.09	1.08	1.20	1.18	1.12	.996
100	1.92	2.17	2.04	2.06	1.91	1.63	1.34	1.12

Table 7.2.5. *R* at Station J2, June 28, 1971, t=1735, h=21°

	R (%)							
Depth	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
0	5.25	5.60	4.51	4.68	4.50	3.32	2.30	1.47
1	5.21	5.56	4.57	4.66	4.41	3.28	2.28	1.50
5	5.17	5.10	4.39	4.51	4.40	3.18	2.38	1.69
10	4.51	4.54	3.88	4.24	4.05	3.10	2.44	1.72
15	4.08	3.93	3.84	3.99	3.99	3.16	2.56	1.82
20	3.74	3.58	3.82	3.72	3.89	2.96	2.67	1.92
25	2.91	3.02	3.78	3.49	3.04	2.67	2.53	2.14
50	1.82	1.99	2.14	2.24	2.37	2.45	2.11	1.91
75	1.84	1.87	1.84	1.86	1.79	1.58	1.84	1.62
100	2.41	2.48	2.55	2.54	2.37	2.06	1.61	1.44

Table 7.2.6. *R* at Station E2, July 6, 1971, t=0900, h=47°

	R (%)							
Depth	**371**	**454**	**465**	**474**	**489**	**502**	**513**	**630**
0	3.60	4.11	3.66	3.70	3.29	2.44	1.81	.102
1	3.63	4.05	3.57	3.66	3.24	2.46	1.78	.105
20	2.10	3.16	2.82	3.07	2.61	2.31	1.68	-
25	1.37	2.65	2.44	2.65	2.29	2.10	1.59	-
50	-	2.21	1.97	2.13	2.07	1.88	1.67	-
75	-	2.02	1.89	2.11	2.12	2.05	1.70	-
100	-	3.59	3.24	2.89	3.00	2.81	2.48	-

Table 7.2.7. R at Station A2, July 12, 1971, t=1440, h=57°

	R (%)							
Depth	**371**	**454**	**465**	**474**	**489**	**502**	**513**	**630**
0	1.40	1.47	1.43	1.51	1.53	1.51	1.33	1.25
50	-	1.05	1.00	1.04	1.09	1.11	.832	-
100	-	3.83	3.52	3.73	3.57	3.29	2.87	-

Table 7.3.1. Coefficients at Station J1, June 24, 1971, t=1045, h=68°

	z_1-z_2	429	454	465	474	489	502	513	528
a	0-5	.024	.020	.021	.022	.022	.027	.033	.047
	5-10	.023	.020	.022	.025	.021	.024	.031	.042
	10-25	.023	.021	.018	.020	.021	.024	.034	.043
	25-50	.034	.029	.027	.026	.026	.032	.037	.045
	50-75	.056	.046	.046	.043	.041	.042	.046	.053
	75-100	.060	.052	.047	.047	.045	.046	.050	.056
K_o	0-5	.037	.031	.032	.035	.033	.038	.046	.064
	5-10	.035	.031	.032	.035	.030	.034	.043	.059
	10-25	.034	.032	.028	.030	.031	.035	.048	.059
	25-50	.050	.043	.039	.037	.037	.044	.051	.062
	50-75	.080	.066	.064	.060	.058	.059	.064	.073
	75-100	.084	.073	.066	.066	.063	.064	.069	.077
K_d	0-5	.036	.030	.031	.033	.032	.038	.046	.064
	5-10	.034	.030	.032	.036	.030	.033	.043	.058
	10-25	.034	.031	.027	.029	.030	.034	.048	.059
	25-50	.049	.042	.038	.037	.037	.044	.051	.062
	50-75	.080	.065	.064	.060	.058	.058	.064	.073
	75-100	.084	.073	.066	.066	.063	.064	.069	.078
K_u	0-5	.050	.043	.049	.062	.045	.050	.052	.046
	5-10	.044	.044	.031	.022	.038	.045	.051	.075
	10-25	.046	.045	.043	.041	.040	.045	.051	.059
	25-50	.060	.050	.049	.045	.043	.040	.045	.050
	50-75	.088	.072	.065	.065	.061	.063	.065	.070
	75-100	.073	.065	.063	.060	.059	.059	.065	.072
a/K_o	0-5	.65	.65	.64	.64	.67	.69	.72	.73
	5-10	.66	.65	.69	.71	.68	.70	.71	.72
	10-25	.67	.66	.65	.67	.69	.70	.72	.73
	25-50	.69	.69	.69	.69	.70	.72	.72	.73
	50-75	.70	.70	.71	.71	.71	.71	.72	.72
	75-100	.72	.71	.71	.71	.71	.72	.72	.72
a/K_d	0-5	.67	.67	.67	.67	.69	.70	.72	.73
	5-10	.67	.67	.68	.70	.69	.70	.72	.72
	10-25	.68	.68	.68	.69	.69	.71	.72	.73
	25-50	.69	.70	.70	.70	.70	.72	.72	.73
	50-75	.71	.71	.71	.71	.71	.71	.72	.72
	75-100	.71	.71	.71	.71	.71	.72	.72	.72
a/K_u	0-5	.48	.47	.43	.36	.49	.53	.64	1.02
	5-10	.52	.46	.72	1.14	.54	.53	.60	.56
	10-25	.49	.47	.42	.48	.52	.54	.68	.73
	25-50	.57	.58	.54	.57	.61	.78	.82	.90
	50-75	.64	.64	.70	.65	.67	.66	.71	.75
	75-100	.82	.79	.75	.79	.77	.78	.77	.77

Table 7.3.1. (cont.)

	z_1-z_2	429	454	465	474	489	502	513	528
K_u/K_d	0-5	1.39	1.42	1.56	1.87	1.40	1.33	1.12	.71
	5-10	1.29	1.45	.94	.61	1.28	1.33	1.20	1.28
	10-25	1.37	1.45	1.62	1.43	1.33	1.32	1.06	1.00
	25-50	1.22	1.19	1.28	1.22	1.15	.92	.88	.80
	50-75	1.11	1.11	1.01	1.08	1.06	1.07	1.02	.97
	75-100	.87	.90	.95	.90	.93	.92	.94	.93

Table 7.3.2. Coefficients at Station J1, June 26, 1971, t=0820, h=42°

	z_1-z_2	371	533	548	574	601	630	649	693
a	0-5	.047	.056	.055	.075	.199	.290	.320	.390
	5-10	.046	.046	.056	.079	.194	.260	-	-
	10-15	.047	.045	.056	.079	-	-	-	-
	15-25	.049	.044	.055	.078	-	-	-	-
	25-50	.086	.056	-	-	-	-	-	-
	50-75	.098	.057	-	-	-	-	-	-
	75-100	-	.058	-	-	-	-	-	-
K_o	0-5	.078	.077	.075	.101	.266	.387	.427	.520
	5-10	.069	.064	.077	.108	.261	.347	-	-
	10-15	.072	.063	.077	.107	-	-	-	-
	15-25	.072	.060	.075	.105	-	-	-	-
	25-50	.119	.076	-	-	-	-	-	-
	50-75	.136	.078	-	-	-	-	-	-
	75-100	-	.080	-	-	-	-	-	-
K_d	0-5	.073	.078	.075	.101	.266	.388	.428	.521
	5-10	.068	.064	.077	.107	.261	.348	-	-
	10-15	.070	.062	.077	.107	-	-	-	-
	15-25	.070	.060	.075	.106	-	-	-	-
	25-50	.119	.076	-	-	-	-	-	-
	50-75	.136	.078	-	-	-	-	-	-
	75-100	-	.080	-	-	-	-	-	-
K_u	0-5	.136	.070	.088	.112	.146	.257	.278	.245
	5-10	.093	.073	.089	.126	.182	.201	-	-
	10-15	.116	.083	.090	.108	-	-	-	-
	15-25	.122	.076	.083	.100	-	-	-	-
	25-50	.126	.068	-	-	-	-	-	-
	50-75	.141	.076	-	-	-	-	-	-
	75-100	-	.073	-	-	-	-	-	-
a/K_o	0-5	.60	.73	.72	.74	.75	.75	.75	.75
	5-10	.66	.72	.73	.74	.75	.75	-	-
	10-15	.66	.72	.73	.74	-	-	-	-
	15-25	.68	.72	.73	.74	-	-	-	-
	25-50	.72	.73	-	-	-	-	-	-
	50-75	.72	.73	-	-	-	-	-	-
	75-100	-	.73	-	-	-	-	-	-
a/K_d	0-5	.64	.72	.73	.74	.75	.75	.75	.75
	5-10	.67	.72	.73	.74	.74	.75	-	-
	10-15	.68	.72	.73	.74	-	-	-	-
	15-25	.70	.73	.73	.74	-	-	-	-
	25-50	.72	.73	-	-	-	-	-	-
	50-75	.72	.73	-	-	-	-	-	-
	75-100	-	.72	-	-	-	-	-	-

Table 7.3.2. (cont.)

	z_1-z_2	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
a/K_u	0-5	.34	.81	.62	.67	1.36	1.13	1.15	1.59
	5-10	.49	.63	.62	.63	1.07	1.29	-	-
	10-15	.41	.54	.62	.73	-	-	-	-
	15-25	.40	.57	.66	.78	-	-	-	-
	25-50	.68	.82	-	-	-	-	-	-
	50-75	.70	.74	-	-	-	-	-	-
	75-100	-	.79	-	-	-	-	-	-
K_u/K_d	0-5	1.86	.90	1.18	1.11	.55	.66	.65	.47
	5-10	1.38	1.15	1.17	1.17	.70	.58	-	-
	10-15	1.66	1.34	1.17	1.01	-	-	-	-
	15-25	1.74	1.27	1.10	.95	-	-	-	-
	25-50	1.06	.89	-	-	-	-	-	-
	50-75	1.04	.98	-	-	-	-	-	-
	75-100	-	.92	-	-	-	-	-	-

Table 7.3.3. Coefficients at Station J2, June 28, 1971, *t*=0830, *h*=42°

	z_1-z_2	371	533	548	574	601	630	649	693
a	0-5	.042	.043	.057	.075	.207	.271	-	-
	5-10	.049	.053	.053	.087	-	-	-	-
	10-15	.046	.042	.064	.088	-	-	-	-
	15-20	.055	.058	.053	.085	-	-	-	-
	20-25	.070	.052	.059	.079	-	-	-	-
	25-50	.098	.058	.064	-	-	-	-	-
	50-75	-	.065	.068	-	-	-	-	-
	75-100	-	.055	.059	-	-	-	-	-
K_o	0-5	.061	.059	.078	.101	.277	.361	-	-
	5-10	.071	.072	.073	.116	-	-	-	-
	10-15	.069	.057	.087	.118	-	-	-	-
	15-20	.080	.079	.072	.115	-	-	-	-
	20-25	.100	.071	.080	.107	-	-	-	-
	25-50	.135	.080	.088	-	-	-	-	-
	50-75	-	.090	.094	-	-	-	-	-
	75-100	-	.075	.082	-	-	-	-	-
K_d	0-5	.061	.059	.078	.101	.277	.362	-	-
	5-10	.070	.073	.073	.117	-	-	-	-
	10-15	.066	.057	.087	.119	-	-	-	-
	15-20	.078	.079	.072	.115	-	-	-	-
	20-25	.098	.071	.080	.107	-	-	-	-
	25-50	.135	.080	.088	-	-	-	-	-
	50-75	-	.090	.094	-	-	-	-	-
	75-100	-	.075	.082	-	-	-	-	-
K_u	0-5	.069	.067	.076	.082	.201	.277	-	-
	5-10	.079	.059	.070	.087	-	-	-	-
	10-15	.123	.065	.074	.094	-	-	-	-
	15-20	.134	.070	.065	.079	-	-	-	-
	20-25	.158	.067	.073	.101	-	-	-	-
	25-50	.129	.061	.064	-	-	-	-	-
	50-75	-	.099	.094	-	-	-	-	-
	75-100	-	.071	.073	-	-	-	-	-
a/K_o	0-5	.68	.73	.74	.74	.75	.75	-	-
	5-10	.69	.73	.74	.74	-	-	-	-
	10-15	.66	.73	.74	.74	-	-	-	-
	15-20	.69	.73	.74	.74	-	-	-	-
	20-25	.71	.73	.73	.74	-	-	-	-
	25-50	.73	.73	.73	-	-	-	-	-
	50-75	-	.72	.72	-	-	-	-	-
	75-100	-	.72	.72	-	-	-	-	-

Table 7.3.3. (cont.)

	z_1-z_2	**371**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
a/K_d	0-5	.69	.73	.74	.74	.75	.75	-	-
	5-10	.69	.73	.74	.74	-	-	-	-
	10-15	.69	.73	.74	.74	-	-	-	-
	15-20	.70	.73	.73	.74	-	-	-	-
	20-25	.72	.73	.73	.74	-	-	-	-
	25-50	.73	.73	.73	-	-	-	-	-
	50-75	-	.72	.72	-	-	-	-	-
	75-100	-	.72	.72	-	-	-	-	-
a/K_u	0-5	.61	.64	.76	.91	1.03	.98	-	-
	5-10	.62	.90	.76	1.00	-	-	-	-
	10-15	.37	.64	.87	.94	-	-	-	-
	15-20	.41	.83	.81	1.08	-	-	-	-
	20-25	.45	.77	.80	.78	-	-	-	-
	25-50	.76	.96	1.01	-	-	-	-	-
	50-75	-	.65	.72	-	-	-	-	-
	75-100	-	.77	.81	-	-	-	-	-
K_u/K_d	0-5	1.13	1.14	.97	.81	.73	.77	-	-
	5-10	1.12	.82	.97	.74	-	-	-	-
	10-15	1.86	1.14	.85	.79	-	-	-	-
	15-20	1.72	.89	.90	.69	-	-	-	-
	20-25	1.61	.94	.91	.94	-	-	-	-
	25-50	.95	.76	.73	-	-	-	-	-
	50-75	-	1.10	1.00	-	-	-	-	-
	75-100	-	.95	.89	-	-	-	-	-

Table 7.3.4. Coefficients at Station J2, June 28, 1971, t=1520, h=47°

	z_1-z_2	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
a	0-5	.027	.022	.018	.019	.027	.024	.032	.048
	5-10	.021	.019	.020	.023	.027	.023	.038	.040
	10-15	.027	.018	.022	.023	.027	.026	.040	.045
	15-20	.025	.023	.020	.021	.023	.034	.036	.039
	20-25	.029	.030	.026	.024	.029	.029	.042	.050
	25-50	.049	.040	.040	.038	.033	.037	.044	.054
	50-75	.074	.064	.060	.058	.054	.053	.057	.062
	75-100	.060	.053	.050	.048	.045	.047	.050	.056
K_o	0-5	.040	.033	.027	.029	.038	.034	.044	.065
	5-10	.033	.027	.028	.033	.038	.032	.052	.054
	10-15	.040	.028	.032	.034	.038	.038	.056	.061
	15-20	.039	.035	.031	.032	.035	.048	.051	.054
	20-25	.042	.044	.036	.033	.041	.041	.057	.068
	25-50	.071	.059	.058	.055	.049	.054	.062	.075
	50-75	.102	.089	.083	.082	.076	.075	.079	.086
	75-100	.082	.072	.068	.066	.062	.065	.069	.077
K_d	0-5	.040	.033	.026	.028	.038	.034	.044	.065
	5-10	.032	.027	.028	.034	.038	.032	.053	.054
	10-15	.040	.027	.032	.033	.039	.038	.056	.062
	15-20	.038	.034	.030	.030	.034	.048	.051	.054
	20-25	.042	.044	.037	.034	.041	.041	.058	.068
	25-50	.070	.058	.057	.054	.048	.053	.062	.075
	50-75	.102	.088	.083	.081	.076	.074	.079	.085
	75-100	.083	.073	.069	.066	.063	.065	.069	.077
K_u	0-5	.037	.034	.037	.034	.033	.035	.047	.058
	5-10	.056	.026	.027	.027	.035	.026	.027	.035
	10-15	.048	.051	.044	.040	.027	.044	.049	.057
	15-20	.064	.048	.052	.056	.050	.047	.055	.067
	20-25	.045	.041	.024	.021	.043	.035	.032	.035
	25-50	.097	.083	.078	.075	.065	.067	.073	.078
	50-75	.118	.104	.098	.097	.089	.086	.089	.095
	75-100	.054	.043	.044	.041	.044	.052	.062	.072
a/K_o	0-5	.68	.68	.66	.68	.70	.70	.72	.73
	5-10	.63	.68	.69	.70	.70	.71	.73	.73
	10-15	.67	.63	.67	.68	.71	.70	.72	.73
	15-20	.65	.67	.66	.65	.67	.71	.71	.72
	20-25	.69	.70	.71	.72	.69	.71	.73	.74
	25-50	.69	.68	.69	.69	.69	.70	.71	.72
	50-75	.72	.72	.72	.72	.71	.71	.72	.72
	75-100	.73	.73	.73	.73	.73	.73	.73	.73

Table 7.3.4. (cont.)

	z_1-z_2	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
a/K_d	0-5	.040	.033	.026	.028	.038	.034	.044	.065
	5-10	.032	.027	.028	.034	.038	.032	.053	.054
	10-15	.040	.027	.032	.033	.039	.038	.056	.062
	15-20	.038	.034	.030	.030	.034	.048	.051	.054
	20-25	.042	.044	.037	.034	.041	.041	.058	.068
	25-50	.070	.058	.057	.054	.048	.053	.062	.075
	50-75	.102	.088	.083	.081	.076	.074	.079	.085
	75-100	.083	.073	.069	.066	.063	.065	.069	.077
a/K_u	0-5	.75	.66	.48	.56	.79	.67	.68	.82
	5-10	.37	.71	.72	.85	.76	.88	1.42	1.12
	10-15	.56	.35	.49	.58	1.00	.60	.82	.79
	15-20	.40	.49	.39	.36	.46	.72	.67	.58
	20-25	.65	.74	1.06	1.11	.66	.84	1.30	1.41
	25-50	.51	.49	.51	.51	.51	.56	.61	.69
	50-75	.62	.61	.61	.60	.61	.62	.64	.65
	75-100	1.13	1.22	1.14	1.19	1.03	.90	.81	.78
K_u/K_d	0-5	.91	1.04	1.43	1.22	.88	1.06	1.06	.89
	5-10	1.76	.96	.95	.82	.92	.80	.51	.65
	10-15	1.22	1.91	1.39	1.19	.70	1.17	.87	.92
	15-20	1.71	1.40	1.74	1.87	1.47	.98	1.07	1.25
	20-25	1.07	.94	.66	.63	1.06	.85	.55	.52
	25-50	1.38	1.43	1.36	1.38	1.36	1.26	1.18	1.05
	50-75	1.16	1.18	1.18	1.19	1.18	1.16	1.13	1.11
	75-100	.65	.60	.64	.61	.70	.80	.90	.94

Table 7.3.5. Coefficients at Station J2, June 28, 1971, *t*=1735, *h*=21°

	z_1-z_2	429	454	465	474	489	502	513	528
a	0-5	.030	.022	.022	.021	.022	.025	.035	.054
	5-10	.024	.017	.018	.023	.023	.028	.044	.046
	10-15	.024	.014	.022	.020	.023	.028	.038	.048
	15-20	.020	.021	.022	.020	.022	.029	.037	.044
	20-25	.028	.026	.027	.024	.026	.031	.038	.056
	25-50	.050	.043	.041	.039	.038	.042	.048	.057
	50-75	.080	.068	.063	.062	.059	.056	.060	.065
	75-100	.044	.041	.040	.039	.037	.040	.041	.046
K_o	0-5	.046	.037	.033	.033	.033	.037	.049	.074
	5-10	.040	.030	.030	.036	.037	.041	.062	.064
	10-15	.038	.025	.032	.032	.035	.040	.054	.067
	15-20	.032	.033	.032	.031	.033	.044	.053	.061
	20-25	.045	.041	.041	.036	.043	.047	.056	.078
	25-50	.073	.064	.061	.059	.055	.060	.069	.080
	50-75	.112	.095	.090	.088	.084	.080	.085	.092
	75-100	.062	.058	.055	.054	.051	.055	.058	.065
K_d	0-5	.046	.035	.033	.033	.033	.036	.049	.075
	5-10	.038	.028	.028	.035	.035	.041	.062	.064
	10-15	.036	.023	.032	.031	.035	.040	.055	.068
	15-20	.031	.032	.033	.030	.033	.043	.053	.062
	20-25	.042	.039	.041	.035	.040	.046	.055	.078
	25-50	.073	.063	.060	.058	.055	.060	.069	.080
	50-75	.112	.095	.090	.088	.084	.080	.085	.091
	75-100	.063	.058	.056	.054	.051	.055	.058	.064
K_u	0-5	.049	.054	.038	.040	.037	.045	.042	.047
	5-10	.065	.051	.053	.047	.052	.046	.057	.061
	10-15	.057	.052	.034	.043	.038	.037	.045	.056
	15-20	.048	.050	.033	.044	.038	.056	.044	.051
	20-25	.092	.073	.043	.048	.089	.066	.066	.057
	25-50	.091	.079	.083	.076	.065	.063	.076	.085
	50-75	.111	.098	.096	.095	.095	.097	.090	.098
	75-100	.052	.047	.043	.042	.040	.045	.064	.069
a/K_o	0-5	.64	.60	.65	.64	.65	.67	.71	.73
	5-10	.59	.58	.60	.63	.63	.68	.70	.72
	10-15	.62	.57	.67	.64	.66	.69	.71	.72
	15-20	.63	.63	.67	.64	.66	.67	.70	.72
	20-25	.61	.63	.67	.65	.60	.67	.69	.72
	25-50	.69	.68	.66	.67	.68	.69	.70	.70
	50-75	.71	.71	.70	.70	.70	.70	.71	.71
	75-100	.71	.71	.72	.72	.72	.72	.71	.71

Table 7.3.5. (cont.)

	z_1-z_2	**429**	**454**	**465**	**474**	**489**	**502**	**513**	**528**
a/K_d	0-5	.64	.62	.66	.65	.66	.68	.70	.72
	5-10	.63	.63	.64	.65	.65	.68	.70	.71
	10-15	.65	.63	.67	.66	.67	.69	.70	.71
	15-20	.66	.66	.67	.66	.67	.68	.70	.71
	20-25	.65	.66	.67	.67	.65	.68	.69	.71
	25-50	.69	.69	.68	.68	.69	.70	.70	.71
	50-75	.71	.71	.71	.70	.70	.70	.71	.71
	75-100	.71	.71	.71	.71	.71	.72	.71	.72
a/K_u	0-5	.60	.41	.56	.53	.58	.55	.82	1.15
	5-10	.37	.34	.34	.48	.44	.61	.76	.76
	10-15	.42	.28	.63	.47	.61	.76	.85	.86
	15-20	.42	.41	.65	.45	.58	.52	.83	.86
	20-25	.30	.36	.64	.49	.29	.47	.58	.98
	25-50	.55	.55	.49	.52	.58	.66	.63	.67
	50-75	.71	.69	.66	.65	.62	.58	.66	.66
	75-100	.86	.88	.93	.92	.91	.89	.65	.67
K_u/K_d	0-5	1.07	1.53	1.16	1.23	1.14	1.24	.86	.63
	5-10	1.72	1.84	1.87	1.36	1.47	1.13	.92	.95
	10-15	1.55	2.26	1.06	1.39	1.09	.90	.82	.83
	15-20	1.57	1.59	1.03	1.47	1.16	1.30	.84	.83
	20-25	2.19	1.86	1.05	1.36	2.24	1.45	1.20	.72
	25-50	1.26	1.27	1.38	1.31	1.18	1.06	1.11	1.06
	50-75	1.00	1.03	1.07	1.08	1.13	1.22	1.06	1.07
	75-100	.83	.81	.77	.77	.78	.81	1.09	1.07

Table 7.3.6. Coefficients at Station E2, July 6, 1971, t=0900, h=47°

	z_1-z_2	371	454	465	474	489	502	513	630
a	0-20	.048	.024	.023	.024	.022	.029	.037	-
	20-25	.047	.023	.022	.020	.026	.028	.037	-
	25-50	-	.039	.038	.036	.035	.037	.043	-
	50-75	-	.054	.051	.048	.045	.046	.050	-
	75-100	-	.058	.055	.053	.050	.051	.054	-
K_o	0-20	.071	.038	.035	.037	.034	.042	.052	-
	20-25	.070	.036	.034	.031	.040	.042	.053	-
	25-50	-	.056	.054	.052	.050	.052	.061	-
	50-75	-	.076	.071	.068	.064	.064	.070	-
	75-100	-	.081	.077	.075	.071	.072	.075	-
K_d	0-20	.070	.037	.034	.036	.033	.042	.051	-
	20-25	.067	.034	.033	.030	.038	.041	.052	-
	25-50	-	.056	.054	.052	.050	.052	.061	-
	50-75	-	.076	.071	.068	.064	.065	.070	-
	75-100	-	.082	.078	.076	.072	.072	.076	-
K_u	0-20	.097	.050	.047	.045	.044	.045	.055	-
	20-25	.152	.069	.062	.059	.065	.060	.063	-
	25-50	-	.063	.063	.061	.054	.057	.059	-
	50-75	-	.080	.073	.068	.063	.061	.069	-
	75-100	-	.059	.057	.063	.058	.060	.061	-
a/K_o	0-20	.67	.65	.66	.66	.67	.70	.71	-
	20-25	.67	.63	.65	.64	.67	.68	.71	-
	25-50	-	.69	.70	.69	.70	.70	.72	-
	50-75	-	.70	.71	.71	.71	.71	.71	-
	75-100	-	.71	.71	.71	.71	.71	.72	-
a/K_d	0-20	.68	.67	.67	.67	.68	.70	.71	-
	20-25	.70	.67	.68	.67	.69	.70	.71	-
	25-50	-	.70	.70	.70	.70	.71	.72	-
	50-75	-	.70	.71	.71	.71	.71	.71	-
	75-100	-	.70	.71	.70	.70	.70	.71	-
a/K_u	0-20	.49	.49	.49	.53	.50	.66	.66	-
	20-25	.31	.33	.36	.34	.41	.48	.59	-
	25-50	-	.62	.60	.60	.65	.65	.74	-
	50-75	-	.67	.69	.70	.72	.75	.72	-
	75-100	-	.98	.97	.84	.87	.85	.89	-
K_u/K_d	0-20	1.39	1.36	1.38	1.26	1.35	1.07	1.07	-
	20-25	2.28	2.04	1.88	1.98	1.68	1.47	1.21	-
	25-50	-	1.13	1.16	1.17	1.08	1.08	.97	-
	50-75	-	1.05	1.02	1.01	.99	.95	.99	-
	75-100	-	.72	.72	.83	.81	.83	.80	-

Table 7.4.1. Mean values of K_d and K_u for the upper ten meters

λ	**371**	**429**	**454**	**465**	**474**	**489**	**502**	**513**
K_d	.069	.038	.032	.031	.033	.035	.037	.050
K_u	.095	.047	.044	.041	.042	.041	.042	.048
K_d/K_u	0.73	0.81	0.73	0.76	0.79	0.85	0.88	1.04
λ	**528**	**533**	**548**	**574**	**601**	**630**	**649**	**693**
K_d	.063	.069	.076	.107	.270	.365	.428	.521
K_u	.054	.067	.081	.102	.183	.253	.278	.245
K_d/K_u	1.17	1.03	0.94	1.05	1.48	1.43	1.54	2.13

PART 3. TABLES FOR RADIANCE AND POLARIZATION AND QUANTITITES DERIVED FROM RADIANCE

h = solar altitude
λ = wavelength
θ = zenith angle
$\theta+$ = zenith angle in solar plane towards the sun
$\theta-$ = zenith angle in solar plane away from the sun
L = radiance
P = degree of polarization
E_u = upward irradiance
E_{ou} = upward scalar irradiance
E_d = downward irradiance
E_{od} = downward scalar irradiance
μ_u = mean cosine of upward radiance
μ_d = mean cosine of downward radiance
Q = ratio between upward irradiance and nadir radiance
R = irradiance ratio E_u/E_d
z_1-z_2 = depth range
a = absorption coefficient
K_o = vertical attenuation coefficient of scalar irradiance $E_o = E_{od} + E_{ou}$
K_d = vertical attenuation coefficient of downward irradiance
K_u = vertical attenuation coefficient of upward irradiance
K_L = vertical attenuation coefficient of radiance from nadir ($\theta=180°$)

The quantities L, E_d, E_{od}, E_u, and E_{ou} are not spectrally calibrated and are presented in relative units (mV).

Table 8.1.1. Station J1, June 26, 1971

Solar time	h °	λ nm	Depth m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1442	52	465	0.5	0	85	-		
1444				10	240	61		
1446	51			20	660	45		
1448				25	790	45		
1450				30	660	45		
1452	50			40	260	40		
1454				50	79	24		
1456				60	45	14		
1458	49			70	25	13		
1500				80	24	11		
1502				90	24	10.6		
1504	48			110	13	8.7		
1506				130	8.7	8.5		
1507				150	7.9	6.9		
1508	47			180	6.6	-		
1509			5	180	5.5	-		
1509				150	6.1	5.3		
1510				130	6.1	5.3		
1510				110	7.9	6.1		
1512				90	24	12		
1514	46			80	40	13		
1516				70	42	14		
1518				60	77	16		
1519	45			50	130	26		
1520				45	400	40		
1522				40	450	40		
1524	44			30	790	53		
1525				25	790	53		
1526				20	530	53		
1528				10	190	61		
1529	43			0	85	-		
1530			15	0	79	-		
1531				10	190	53		
1533				20	530	58		
1534	42			25	1060	61		
1535				30	2600	53		
1535				40	660	34		
1536				45	420	32		
1537				50	210	21		
1538				60	98	13		
1539	41			70	53	10.6		
1540				80	34	8.5		
1541				90	19	7.9		
1542				110	7.7	5.3		
1543				130	4.2	4.0		
1544				150	4.0	3.4		
1544				180	3.4	-		

Table 8.1.1. Station J1, June 26, 1971 (cont.)

Solar time	h °	λ nm	**Depth** m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1545	40	465	25	180	2.1	-		
1546				150	2.4	2.1		
1547				130	2.6	2.5		
1548				110	4.8	3.6		
1549				90	13	5.0		
1550	39			80	21	6.1		
1551				70	40	7.9		
1552				60	79	10.6		
1553				50	190	13		
1554				40	660	20		
1555	38			30	1050	24		
1556				25	530	37		
1557				20	260	40		
1558				10	130	45		
1559				0	61	-		
1600	37		50	0	32	-		
1601				10	50	21		
1602				20	79	15		
1603				25	120	12		
1604				30	190	10.6		
1605	36			35	190	8.7		
1606				40	160	7.9		
1607				50	61	5.8		
1608				60	24	4.0		
1609				70	13	2.6		
1610				80	6.1	1.7		
1611	35			90	3.2	1.2		
1612				110	1.05	.66		
1613				130	.54	.49		
1614				150	.40	.40		
1615				180	.40	-		
1618	34		100	180	.019	-		
1619				150	.020	.017		
1620				130	.022	.019		
1621	33			110	.030	.025		
1622				90	.062	.042		
1623				80	.105	.060		
1624				70	.22	.100		
1625				60	.43	.160		
1626	32			50	.95	.28		
1627				40	1.9	.45		
1628				35	2.4	.60		
1629				30	2.9	.65		
1630				25	3.0	.85		
1631	31			20	3.0	1.00		
1632				10	3.0	1.40		
1633				0	2.0	-		

Table 8.1.1. Station J1, June 26, 1971 (cont.)

Solar time	h °	λ nm	Depth m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1634	31	465	150	0	.22	-		
1635				10	.29	.21		
1636	30			20	.28	.15		
1637				25	.22	.098		
1638				30	.19	.090		
1639				35	.19	.080		
1640				40	.15	.065		
1641				50	.075	.035		
1642	29			60	.030	.017		
1643			150	0	.22			
1644			160		.13			
1645			170		.090			
1646			190		.055			
1655	27		190		.045			
1656			185		.055			
1657	26		180		.070			
1657			175		.080			
1657			170		.10			
1658			165		.12			
1658			160		.14			
1659			155		.16			
1659			150		.19			
1659			145		.22			
1659			140		.25			
1700			135		.29			
1700			130		.33			
1700			125		.40			
1700			120		.50			
1701			115		.55			
1701			110		.69			
1701			105		.80			
1701			100		1.0			
1702			95		1.3			
1702			90		1.5			
1702			85		1.8			
1703			80		2.2			
1703			75		3.0			
1703			70		4.0			
1703	25		65		5.9			
1704			60		9.5			
1704			55		14			
1704			50		20			
1704			45		40			
1705			40		65			
1705			35		49			
1705			30		35			
1705			25		45			
1705			20		30			
1706			15		35			

Table 8.1.1. Station J1, June 26, 1971 (cont.)

Solar time	*h* °	λ nm	Depth m	*θ* °	*L*(*θ*+)	*L*(*θ*-)	*P*(*θ*+) %	*P*(*θ*-) %
1706	25	465	10	0	40			
1706			5		100			
1706			0		150			

Table 8.1.2. Station J2A, July 2, 1971

Solar time	*h* °	λ nm	Depth m	*θ* °	*L*(*θ*+)	*L*(*θ*-)	*P*(*θ*+) %	*P*(*θ*-) %
1206	74	465	1	0	310	-	-	-
1207				5	490	240	-	-
1208				10	1300	165	-	-
1209				15	420	125	1.3	15.2
1211				20	450	110	1.7	20.4
1212				25	220	82	2.2	26.6
1216				30	200	76	2.6	37.9
1214				35	165	66	8.7	44.0
1215				40	125	41	13.1	50.0
1216				45	87	31	-	-
1217				50	52	17.5	-	-
1219				60	18.0	11.0	32.6	51.8
1221				70	18.0	10.5	44.5	55.3
1222				80	18.0	18.0	51.8	61.0
1225				90	20.0	18.0	58.0	63.0
1228	73			110	16.0	14.0	54.5	37.0
1228				130	13.5	11.5	43.0	15.7
1229				150	12.0	10.0	23.1	8.7
1230				180	11.5	-	3.9	-
1235			5	180	9.2	-	3.0	-
1236				150	10.5	9.0	20.8	3.5
1237				130	11.5	9.0	40.4	18.7
1238				110	14.0	11.5	57.3	32.5
1239	72			90	22	16.5	54.0	58.2
1241				80	26	20	49.0	58.2
1242				70	30	21	44.7	56.0
1243				60	32	21	34.7	50.4
1244				50	58	22	26.9	40.8
1245				45	69	28	20.8	44.5
1246				40	135	41	14.8	45.6
1247				30	220	74	4.8	40.8
1248	71			25	380	90	-	-
1249				20	500	100	1.7	23.9
1250				15	5700	115	-	-
1252				10	280000	145	1.3	11.7
1253				5	2800	165	-	-
1255				0	360	-	5.7	-
1305	69		10	0	330	-	3.9	-
1307				10	1800	320	-	-
1308				15	52000	105	0.9	19.6
1309				20	1550	80	0.4	23.5
1310				25	530	71	-	-
1311	68			30	290	67	2.2	37.4
1312				35	230	56	-	-
1313				40	165	53	10.9	46.1
1314				45	83	44	14.8	53.2
1315				50	76	33	19.6	49.5
1316				55	56	24	-	-

Table 8.1.2. Station J2A, July 2, 1971 (cont.)

Solar time	***h*** °	λ nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
1317	67	465	10	60	44	19.5	30.9	54.9
1318				70	34	17.5	38.7	64.0
1319				80	28	16.5	48.3	67.0
1319				90	22	14.0	56.0	60.5
1320				110	11.5	8.7	61.4	35.2
1322				130	9.0	7.9	43.5	13.1
1323				150	9.0	7.1	25.2	0.8
1324	66			180	7.1	-	3.5	-
1325			15	180	5.5	-	3.9	-
1326				150	6.3	5.3	25.7	0.8
1327				130	7.1	6.1	43.5	12.6
1328				110	9.0	6.9	57.9	34.0
1329				90	18.5	11.0	46.5	60.0
1329				80	30	15.0	39.1	60.0
1330	65			70	40	17.5	30.4	57.9
1331				60	58	20	20.9	50.0
1332				50	99	28	14.4	47.5
1333				40	200	48	7.4	47.9
1334				30	480	63	1.7	35.6
1335				25	1200	84	-	-
1336	64			20	4700	89	0.4	20.9
1339				15	10500	97	-	-
1340				10	1950	105	0.4	13.9
1341				5	540	140	-	-
1342	63			0	240	-	3.5	-
1343			25	0	230	-	1.3	-
1345				5	480	130	-	-
1346				10	1050	110	0.9	17.4
1348	62			15	4000	84	-	3.6
1349				20	5300	87	0.4	28.6
1350				25	1050	74	-	-
1351				30	480	61	0.9	36.8
1353	61			40	185	29	4.3	48.6
1355				50	84	20	11.3	45.6
1357				60	50	17.0	17.8	50.8
1359	60			70	30	11.0	22.6	54.3
1400				80	18.0	7.7	30.4	56.9
1402				90	10.5	5.8	39.5	54.7
1404	59			110	5.0	4.0	51.6	24.3
1405				130	3.4	3.0	43.4	8.2
1406				150	3.1	2.7	26.5	0.4
1408				180	2.7	-	3.9	-
1410	58		50	180	.40	-	4.8	-
1412				150	.45	.40	22.1	2.6
1413				130	.51	.44	46.4	11.0
1415	57			110	.61	.50	46.4	26.0
1416				90	1.80	1.05	33.2	48.6

Table 8.1.2. Station J2A, July 2, 1971 (cont.)

Solar time	*h* °	λ nm	Depth m	*θ* °	*L*(*θ*+)	*L*(*θ*-)	*P*(*θ*+) %	*P*(*θ*-) %
1417	57	465	50	80	3.2	1.40	23.4	48.2
1418				70	6.3	2.1	17.4	46.4
1419				60	10.5	2.9	11.3	44.2
1420				50	21	4.8	5.2	42.5
1421	56			40	40	6.9	3.0	35.6
1422				30	90	11.0	0.4	33.0
1423				25	145	14.0	-	-
1424				20	250	16.0	0.4	24.8
1425				15	190	19.5	-	-
1426	55			10	130	30	1.7	16.1
1427				5	90	33	-	-
1428				0	49	-	4.8	-
1429			75	0	6.9	-	-	-
1430				5	9.5	4.2	-	-
1431	54			10	10.5	2.5	0.4	15.2
1432				15	7.4	2.2	-	-
1433				20	5.8	2.0	0.0	21.8
1434				25	8.4	1.85	-	-
1435				30	6.9	1.50	0.4	28.3
1436				40	3.4	.90	2.6	30.0
1437	53			50	1.65	.45	5.7	34.8
1438				60	.82	.29	11.3	41.4
1439				70	.40	-	17.4	48.7
1441				0	7.4	-	1.3	-
1441			70	0	10.5			
1441			65		16.0			
1441			60		24			
1441			55		40			
1442	52		50		63			
1442			45		79			
1442			40		90			
1442			35		130			
1442			30		155			
1442			25		170			
1442			20		175			
1443			15		185			
1443			10		185			
1444			5	0	185	-	5.6	-
1445				5	340	77	-	-
1446				10	430	69	2.6	32.5
1448	51			15	1400	61	-	-
1449				20	5400	59	3.0	45.6
1450				25	1950	58	-	-
1451				30	760	56	2.6	54.2
1452	50			40	230	21	5.2	63.0
1453				50	100	17.5	11.3	64.3
1454				60	58	18.5	24.7	51.2

Table 8.1.2. Station J2A, July 2, 1971 (cont.)

Solar time	h °	λ nm	**Depth** m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1455	50	465	5	70	42	18.0	30.4	58.2
1456				80	35	16.5	38.6	60.7
1457	49			90	25	15.5	45.2	59.0
1458				110	13.0	10.0	58.6	13.9
1459				130	10.6	7.9	48.6	2.2
1500				150	9.2	7.4	32.1	1.7
1501				180	7.9	-	9.1	-
1523	44			0	92	-	18.2	-
1525				10	165	63	3.0	29.5
1526				20	400	55	1.7	46.9
1527				25	630	53	-	-
1528	43			30	3400	54	3.5	52.6
1529				35	4500	63	-	-
1530				40	790	55	3.5	54.7
1531				45	450	45	1.7	54.5
1532				50	260	29	1.3	52.5
1533				60	79	20	6.1	52.5
1534	42			70	58	16.0	17.4	54.3
1535				80	45	16.0	28.6	57.3
1536				90	34	15.5	41.2	58.6
1537				110	15.5	10.5	57.8	13.9
1538				130	9.5	7.5	51.6	2.2
1539	41			150	8.2	6.6	34.7	1.3
1540				180	6.9	-	11.3	-
1547	40		1	180	8.7			
1547			5		7.1			
1547			10		5.5			
1547			15		4.0			
1547			20		3.0			
1548			25		2.3			
1548			30		1.50			
1548			35		1.00			
1548			40		.69			
1548			45		.44			
1549	39		50		.28			
1551			50	130	.34	-	43.7	8.3
1552				110	.69	.48	45.2	28.7
1553				90	2.1	.87	19.1	45.7
1554	38			80	4.1	1.25	14.3	46.6
1555				70	9.0	1.95	6.1	46.1
1556				60	17.5	3.0	3.0	43.5
1558				50	40	4.5	0.9	44.4
1559	37			40	87	6.9	0.9	43.5
1600				35	140	7.9	-	-
1601				30	125	8.4	1.3	40.0
1602				25	87	9.8	-	-
1603				20	63	10.5	2.2	32.6
1604	36			10	40	14.5	0.9	24.0

Table 8.1.2. Station J2A, July 2, 1971 (cont.)

Solar time	***h*** °	**λ** nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
1605	36	465	50	5	32	15.0	-	-
1606				0	23	-	13.5	-
1610	35		5	0	63	-	27.8	-
1611				10	125	55	13.5	50.0
1612				15	180	50	-	-
1613.				20	290	50	3.0	56.5
1614				25	400	50	-	-
1615	34			30	1550	53	1.7	56.5
1616				35	2900	58	-	-
1617				40	4500	58	4.8	54.4
1618				45	550	38	4.8	55.4
1619				50	210	18.5	3.9	55.6
1620	33			60	90	16.0	7.8	52.1
1622				70	50	15.0	17.4	43.5
1623				80	44	12.5	25.2	34.8
1624				90	32	12.0	34.3	28.2
1625	32			110	13.5	8.4	53.1	11.8
1626				130	8.2	6.6	55.2	0.4
1627				150	7.1	5.5	39.1	0.9
1628				180	5.8	-	-	-
1632	31		50	130	.28	-	45.6	4.8
1634				110	.54	.36	50.6	18.3
1635	30			90	1.61	.63	19.6	42.8
1636				80	3.2	.90	8.7	44.8
1637				70	6.1	1.30	4.1	45.7
1638				60	12.0	2.0	2.2	43.0
1639				50	27	3.1	0.4	41.4
1640	29			45	34	4.0	0.9	43.1
1641				40	54	4.8	1.7	44.0
1642				35	61	5.8	-	-
1643				30	65	7.0	1.7	44.4
1644				25	53	7.7	-	-
1645	28			20	44	8.2	0.9	43.5
1646				15	37	9.2	-	-
1647				10	30	10.0	1.3	37.4
1648				5	25	10.5	-	-
1649				0	16.0	-	-	-
1652	27		5	0	50	-	46.0	-
1655				5	71	45	-	-
1657	26			10	84	45	17.4	58.3
1658				15	115	42	-	-
1700				20	130	44	5.7	60.8
1702	25			25	190	45	-	-
1704				30	340	53	2.6	58.7
1705				35	540	53	-	-
1706	24			40	1850	55	5.7	56.0
1707				45	2600	37	5.7	59.6

Table 8.1.2. Station J2A, July 2, 1971 (cont.)

Solar time	h °	λ nm	Depth m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1708	24	465	5	50	530	18.5	2.2	61.0
1709				60	105	12.0	0.9	54.4
1710				70	55	11.0	4.4	40.0
1711	23			80	41	11.0	13.0	27.0
1712				90	29	10.0	21.3	15.2
1712				110	11.0	6.3	37.0	3.9
1713				130	5.8	4.8	53.6	0.4
1714				150	4.8	4.0	41.8	0.0
1715				180	4.0	-	18.3	-
1720	22		50	110	.44	-	-	-
1722	21			90	1.60	.54	-	-
1723				80	3.0	.90	-	-
1724				70	6.6	1.30	-	-
1725				60	13.5	2.2	-	-
1726				50	28	3.3	-	-
1727	20			45	34	4.0	-	-
1728				40	32	4.8	-	-
1729				35	27	5.5	-	-
1730				30	23	6.2	-	-
1731				25	20	6.6	-	-
1732	19			20	16.5	7.1	-	-
1732				15	15.5	7.7	-	-
1733				10	13.5	7.9	-	-
1734				0	11.5	-	19.2	-
1740	18			0	9.5		-	-
1752	16			10	12.0	6.9	10.9	34.0
1754	15			20	14.0	6.2	5.7	44.4
1755				30	18.0	5.5	0.4	45.3
1757				35	18.5	5.0	-	-
1759	14			40	21	4.2	3.0	44.8
1800				50	17.0	2.9	2.6	42.5
1801				60	6.6	1.70	0.9	41.4
1802				70	3.2	.95	0.4	41.4
1803				80	1.45	.58	6.5	41.0
1805	13			90	.79	.37	10.9	39.2
1806				100	.45	-	-	-
1807				0	6.9	-	-	-
1810	12		25	0	21	-	32.6	-
1811				10	28	17.5	23.4	46.6
1811				20	34	15.5	17.4	53.0
1812				30	41	15.5	3.0	52.2
1813				40	53	14.5	3.0	58.2
1814				45	87	11.5	5.7	56.6
1815	11			50	92	9.0	5.7	52.2
1816				60	34	5.3	3.0	41.3
1817				70	9.5	3.2	1.3	35.7
1817				80	4.0	1.80	1.7	30.0
1818				90	1.95	1.10	4.8	23.9

Table 8.1.2. Station J2A, July 2, 1971 (cont.)

Solar time	h °	λ nm	Depth m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1819	11	465	25	110	.71	.50	30.8	4.8
1820				130	.41	.32	41.3	0.9
1821	10			150	.32	-	33.1	6.1
1824			5	180	.74	-	21.3	-
1825				150	.87	.74	35.2	13.0
1826				130	1.10	.84	36.9	0.4
1827	9			110	2.0	1.25	33.9	2.2
1829				90	4.5	1.95	26.1	10.5
1830				80	7.1	2.2	9.1	21.7
1831				70	13.0	2.6	0.9	30.9
1832				60	40	3.2	4.8	47.9
1833	8			50	160	5.5	7.0	59.6
1834				45	105	7.7	7.0	64.1
1835				40	79	15.5	3.9	58.7
1837				30	48	19.0	4.8	63.5
1838	7			20	30	17.0	19.6	65.2
1839				10	21	16.0	47.4	64.3
1841				0	15.0	-	59.5	-
1843			25	0	8.2	-	46.5	-
1844	6			5	10.0	7.4	-	-
1844				10	-	-	26.1	67.5
1845				15	14.0	7.4	-	-
1846				20	16.0	8.4	16.5	37.0
1847				25	17.0	8.7	-	-
1848				30	18.0	7.9	3.9	50.0
1849	5			35	18.0	7.4	-	-
1850				40	18.0	6.3	0.4	34.8
1851				45	15.0	5.5	0.4	54.0
1852				50	10.5	3.7	1.7	46.2
1853				60	4.8	2.0	1.7	34.4
1854				70	2.3	1.20	0.4	24.3
1855				80	1.25	.74	1.3	-
1856	4			90	.69	.46	3.0	-
1902	3		5	0	11.5	-	58.7	-
1903				10	12.5	10.5	51.8	67.5
1904				20	16.0	11.0	34.0	67.0
1905				30	22	10.5	3.5	61.7
1906	3			40	29	4.5	4.8	53.9
1907	2			45	30	4.1	6.5	45.8
1908				50	19.5	1.45	8.7	39.2
1909				60	3.0	.90	2.6	36.9
1910				70	1.60	.82	1.7	39.2
1911				80	1.25	.77	2.2	33.9
1911				90	1.00	.55	10.0	27.8
1912				110	.50	.34	34.3	2.2
1913			25	0	5.8	-	-	-

Table 8.1.2. Station J2A, July 2, 1971 (cont.)

Solar time	*h* °	λ nm	**Depth** m	*θ* °	*L*(*θ*+)	*L*(*θ*-)	*P*(*θ*+) %	*P*(*θ*-) %
1915	1	465	25	15	4.2	2.5	-	-
1916				30	4.8	2.4	-	-
1917				45	4.0	1.75	-	-
1918				60	1.10	.66	-	-
1919				0	4.0	-	-	-
1921	0			20	5.3	3.7	-	-
1922	sunset			40	10.5	1.15	-	-
1923				60	1.20	.37	-	-

Table 8.1.3. Station E2, July 6, 1971

Solar time	*h* °	λ nm	Depth m	*θ* °	*L*(*θ*+)	*L*(*θ*-)	*P*(*θ*+) %	*P*(*θ*-) %
1439	53	465	1	0	145	-	8.7	-
1443	52			5	220	105	-	-
1444				10	390	92	3.5	18.7
1445				15	750	85	-	-
1447	51			20	1100	73	5.7	34.8
1450				25	2200	67	-	-
1454	50			30	2300	63	6.1	41.4
1455				40	410	61	6.1	41.7
1457	49			45	360	51	-	-
1459				50	170	36	-	-
1501				60	75	11.5	-	-
1516			5	180	9.0	-	10.4	-
1517	45			150	9.5	8.2	38.4	4.4
1518				130	11.0	8.2	51.8	3.5
1519				110	16.0	10.5	38.2	18.3
1520				90	29	15.0	39.2	34.8
1521				80	29	16.0	31.3	43.0
1522	44			70	30	15.0	24.4	42.6
1523				60	96	16.5	8.7	38.8
1525				50	220	24	6.1	38.4
1526				40	650	58	10.4	40.0
1527				30	2400	66	7.8	40.9
1528				25	1000	66	-	-
1529	43			20	580	67	4.4	39.2
1530				10	250	79	1.7	25.7
1531				0	115	-	14.8	-
1532				0	110	-	10.4	-
1533	42			10	240	75	2.2	21.4
1534				20	490	65	4.8	32.6
1535				25	1700	62	-	-
1536				30	9800	62	7.4	37.6
1537				35	4200	62	-	-
1538	41			40	940	51	7.0	37.6
1540				50	300	31	5.2	34.8
1541				60	75	20	7.8	48.8
1542				70	51	18.5	14.8	49.6
1543	40			80	40	17.0	21.4	49.6
1544				90	31	14.5	28.7	39.2
1545				110	15.0	10.5	46.5	11.3
1547				130	10.5	8.6	47.0	0.9
1548	39			150	8.6	6.9	31.8	4.4
1549				180	7.1	-	10.9	-
1602	37		15	180	3.8	-	10.9	-
1603	36			150	4.4	3.6	25.7	1.7
1604				130	4.4	3.6	40.0	4.4
1605				110	4.6	3.8	51.3	11.7
1607				90	6.9	5.1	18.3	33.5
1608				80	38	13.0	11.8	43.5

Table 8.1.3. Station E2, July 6, 1971 (cont.)

Solar time	h °	λ nm	Depth m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1609	35	465	15	70	65	15.0	6.1	41.8
1610				60	115	18.5	3.0	37.0
1611				50	240	34	4.4	33.5
1612				40	1250	38	6.1	31.4
1614	34			35	1750	41	-	-
1615				30	980	45	7.0	34.0
1616				25	460	47	-	-
1617				20	310	51	6.1	27.8
1618				10	150	56	1.3	20.4
1619	33			0	79	-	10.9	-
1627	32		50	0	22	-	4.4	-
1628				10	36	17.0	0.9	13.1
1629	31			20	51	12.0	3.9	21.8
1630				25	61	11.5	-	-
1631				30	64	9.9	6.1	29.6
1632				35	67	8.2	-	-
1633				40	71	7.8	6.5	31.1
1634	30			50	36	5.1	4.8	31.8
1635				60	17.0	3.4	3.5	34.4
1636				70	3.4	2.1	3.9	37.4
1637				80	3.6	1.20	5.2	39.2
1639	29			90	1.95	.87	14.4	37.9
1641				110	.65	.45	37.5	18.7
1642				130	.38	.32	42.2	4.8
1643				150	.29	-	29.2	2.6
1644	28			180	-	-	10.4	-
1646				0	19.0	-	-	-
1650	27		100	0	.75	-	-	-
1651				10	.90	.61	-	-
1652				20	.87	.44	-	-
1653				30	.77	.32	-	-
1654				40	.51	-	-	-
1700	26		5	0	67	-	30.0	-
1702	25			10	96	54	12.2	47.5
1703				20	185	51	2.6	47.5
1704				30	430	54	5.7	46.1
1705	24			35	700	54	-	-
1707				40	3000	51	5.7	40.9
1708				50	510	29	3.0	42.2
1709				60	200	13.0	3.0	42.2
1711	23			70	61	12.5	7.0	34.8
1712				80	40	11.0	11.3	32.6
1713				90	28	9.5	17.4	23.1
1717	22			110	10.5	6.1	37.9	7.4
1718				130	5.4	4.4	44.5	0.9
1719				150	4.4	3.4	33.0	0.9
1720				180	3.3	-	17.8	-

Table 8.1.3. Station E2, July 6, 1971 (cont.)

Solar time	***h*** °	**λ** nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
1724	21	628	5	0	.77	-	-	-
1725				10	1.15	.59	-	-
1726	20			15	1.30	.55	-	-
1727				20	1.85	.47	-	-
1728				30	7.4	.45	-	-
1729				60	1.60	.49	-	-

Table 8.1.4. Station D2, July 7, 1971

Solar time	*h* °	λ nm	Depth m	*θ* °	*L*(*θ*+)	*L*(*θ*-)	*P*(*θ*+) %	*P*(*θ*-) %
0648	23	465	1	0	54	-	30.5	-
0649				10	105	54	13.9	38.8
0651	24			20	180	54	7.4	42.7
0652				25	270	58	-	-
0654				30	490	63	1.7	43.1
0656	25			35	620	65	-	-
0658				40	1950	73	4.8	39.2
0659				50	240	8.6	7.4	34.0
0700				60	20	7.8	13.9	37.4
0702	26			70	19.5	8.2	18.7	41.4
0704				80	19.5	8.6	23.5	44.0
0705				90	20	9.0	29.6	42.7
0707	27			110	11.0	6.6	43.5	11.3
0708				130	6.3	5.5	41.4	2.6
0709				150	5.8	5.1	32.2	0.9
0710				180	5.1	-	12.6	-
0712	28		5	180	4.2	-	10.9	-
0714				150	5.0	4.4	34.4	1.3
0715				130	5.5	5.0	41.8	3.5
0716				110	9.0	6.3	44.0	10.4
0717	29			90	20	8.6	30.9	39.2
0718				80	28	9.5	22.6	43.6
0720				70	36	11.0	16.1	44.0
0721				60	54	12.0	10.0	41.4
0723	30			50	105	14.0	2.6	35.7
0724				45	370	14.5	5.2	32.6
0725				40	1400	48	5.2	34.0
0726				35	4900	67	-	-
0727	31			30	980	67	3.9	37.0
0729				20	650	67	2.6	37.4
0731				10	370	67	2.2	34.4
0733	32			0	100	-	18.3	-
0735			10	0	91	-	20.4	-
0736				10	185	67	4.4	25.7
0737	33			20	350	65	1.7	29.6
0738				25	550	65	-	-
0739				30	1250	65	3.9	32.6
0740				35	4500	61	-	-
0741				40	1400	51	3.0	38.7
0742	34			45	430	31	2.6	39.2
0743				50	172	18.5	0.9	36.1
0744				60	71	14.0	8.3	36.5
0745				70	48	12.5	13.9	42.5
0746				80	32	12.0	21.3	44.7
0747	35			90	20	10.0	30.5	43.1
0748				110	9.9	7.4	45.2	11.3
0749				130	6.6	5.8	40.5	3.5
0750				150	5.5	5.0	24.8	0.9

Table 8.1.4. Station D2, July 7, 1971 (cont.)

Solar time	h °	λ nm	**Depth** m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
0751	35	465	10	180	4.8	-	7.4	-
0752	36		15	180	4.2	-	8.7	-
0753				150	4.8	4.0	29.6	1.3
0755				130	5.8	4.8	45.2	2.6
0756				110	8.6	6.6	43.0	13.9
0757				90	19.5	9.5	27.0	37.0
0758	37			80	30	11.0	19.5	42.7
0759				70	48	13.0	13.9	44.3
0800				60	75	15.0	7.4	42.2
0801				50	185	26	2.6	38.3
0802				40	780	42	2.2	27.4
0803	38			35	2200	61	-	-
0804				30	6100	61	3.0	33.9
0805				25	1400	65	-	-
0806				20	510	67	2.4	34.3
0807				10	240	75	0.9	26.1
0809	39			0	115	-	13.9	-
0810			25	0	96	-	11.3	-
0811				10	200	65	1.7	30.8
0812				20	430	51	2.6	34.8
0813	40			25	880	51	-	-
0814				30	2200	51	1.7	33.4
0815				35	1250	48	-	-
0816				40	470	40	1.3	34.4
0817				50	160	20	1.3	40.9
0818	41			60	75	16.0	7.8	45.2
0819				70	42	12.0	13.9	46.9
0820				80	25	9.5	21.7	44.8
0821				90	15.0	7.4	28.6	37.4
0822				110	6.3	4.9	46.5	14.8
0823	42			130	4.0	3.5	42.6	4.8
0824				150	3.5	3.0	31.3	1.3
0825				180	3.0	-	9.1	-
0827			50	180	.48	-	3.5	-
0827				150	.53	.45	24.8	1.3
0828	43			130	.61	.55	41.4	6.1
0829				110	.92	.71	42.7	20.9
0830				90	2.2	1.20	29.6	36.6
0831				80	2.6	1.65	20.5	42.1
0832				70	7.8	2.5	13.5	43.1
0833	44			60	15.0	3.8	7.4	40.5
0834				50	30	6.1	3.5	34.8
0835				40	100	9.5	0.9	36.6
0836				35	110	12.0	-	-
0837				30	200	14.5	0.9	33.9
0838				25	210	17.0	-	-
0839	45			20	200	19.5	2.2	27.5

Table 8.1.4. Station D2, July 7, 1971 (cont.)

Solar time	*h* °	λ nm	Depth m	*θ* °	*L*(*θ*+)	*L*(*θ*-)	*P*(*θ*+) %	*P*(*θ*-) %
0840	45	465	50	10	91	24	1.3	17.4
0841				0	51	-	6.5	-
0843			100	0	2.4	-	4.8	-
0845	46			10	3.3	1.50	1.3	10.9
0847				20	3.4	1.10	1.3	17.9
0849	47			25	3.2	.87	-	-
0851				30	2.5	.66	0.9	23.5
0852				35	1.80	.55	-	-
0853				40	1.27	.40	2.2	27.9
0854	48			50	.61	-	5.7	37.0
0859	49		50	0	54	-	6.5	-
0900				10	120	28	1.7	16.1
0902				20	260	22	0.9	23.1
0903				25	370	19.5	-	-
0905	50			30	185	17.0	0.9	30.5
0906				35	115	14.0	-	-
0907				40	75	12.0	1.7	34.8
0909				50	25	7.8	4.8	36.1
0910	51			60	19.5	5.1	9.6	39.2
0911				70	10.0	3.3	15.2	41.4
0913				80	8.2	2.3	22.2	42.7
0914				90	2.7	1.55	30.5	41.7
0915	52			110	1.20	1.10	44.4	22.2
0916				130	.84	.77	39.6	10.0
0918				150	.77	.71	23.1	2.2
0920	53			180	.71	-	5.7	-
0925	54		25	180	4.2	-	4.4	-
0927				150	4.9	4.2	24.0	0.9
0929				130	5.4	4.8	40.9	5.7
0931	55			110	7.4	6.1	46.9	20.4
0933				90	16.0	9.5	35.2	47.8
0934				80	25	12.0	29.6	48.7
0936	56			70	40	15.0	22.2	47.4
0938				60	65	19.5	15.2	44.4
0940				50	100	26	8.3	39.6
0941	57			40	210	36	3.0	36.1
0942				35	320	44	-	-
0943				30	510	54	0.9	33.9
0945				25	1150	57	-	-
0947	58			20	6900	61	0.9	27.8
0949				15	6900	81	-	-
0951				23	1650	65	-	-
0952	59			18	12000	71	-	-
0953				10	1400	115	0.9	15.7
0954				0	240	-	5.7	-
0955			15	0	320	-	5.2	-

Table 8.1.4. Station D2, July 7, 1971 (cont.)

Solar time	*h* °	λ nm	**Depth** m	*θ* °	*L*(*θ*+)	*L*(*θ*-)	*P*(*θ*+) %	*P*(*θ*-) %
0956	59	465	15	10	1800	140	0.9	15.2
0958	60			15	17500	130	-	-
1000				20	2400	96	0.9	22.6
1002				30	590	75	1.3	31.2
1004	61			40	280	44	3.0	32.5
1006				45	160	38	6.5	33.0
1008				50	100	31	10.9	34.4
1009	62			60	65	25	20.9	42.1
1010				70	44	22	29.2	46.5
1012				80	32	18.5	35.6	47.8
1014	63			90	21	14.0	40.0	46.1
1015				110	11.5	10.0	46.9	24.3
1017				130	10.0	8.6	36.6	8.7
1023	64			150	9.0	7.8	19.5	0.9
1026	65			180	6.1	-	3.9	-
1027			5	180	11.5	-	5.2	-
1029				150	12.0	10.0	20.9	2.2
1031				130	14.0	10.5	40.9	7.0
1033	66			110	16.0	12.0	50.9	23.5
1034				90	24	16.0	46.5	53.1
1036				80	31	18.5	40.0	53.5
1038	67			70	36	19.5	31.3	53.1
1039				60	40	22	22.2	44.4
1040				50	63	21	16.1	46.1
1041				45	92	36	10.4	42.2
1043				40	165	34	5.2	37.0
1044				30	410	61	2.2	27.4
1045	68			20	840	87	0.9	19.1
1046				15	1500	140	-	-
1048				10	6600	170	0.9	12.6
1049				5	580	220	-	-
1050				0	390	-	5.2	-
1303	69	628	1	0	82	-	7.4	-
1304				5	200	51	-	-
1306				10	400	29	3.0	14.8
1308				15	300	22	-	-
1310	68			12	650	28	-	-
1311				20	470	16.0	1.3	21.3
1312				25	140	12.5	-	-
1314				30	75	11.5	2.2	27.9
1316	67			40	38	8.2	4.8	-
1317				60	-	.30	-	-
1318				70	.49	-	-	-
1319			3	0	17.0	-	6.1	-
1320				5	34	14.5	-	-
1321				10	57	12.0	2.2	13.5
1322				15	140	8.2	-	-

Table 8.1.4. Station D2, July 7, 1971 (cont.)

Solar **time**	h °	λ nm	**Depth** m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1323	66	628	3	20	590	6.6	1.7	21.3
1325				25	75	5.1	-	-
1326				30	36	3.8	2.6	30.5
1327				40	17.0	2.3	5.2	38.0
1328				45	7.8	1.40	7.4	38.8
1329	65			50	3.8	.61	10.0	39.2
1331				60	.82	-	17.9	37.4
1332				70	-	-	37.4	-
1333				0	13.0	-	-	-
1334			6	0	6.3	-	4.4	-
1335	64			5	13.0	5.1	-	-
1336				10	25	3.7	1.7	15.2
1337				15	91	2.8	-	-
1338				20	300	1.90	1.3	24.8
1339				30	12.0	1.30	2.2	32.3
1341	63			25	82	1.65	-	-
1342				40	4.6	.74	5.2	31.4
1343				45	2.7	.38	7.0	34.0
1344				50	1.40	.50	9.1	44.4
1345				60	-	-	19.2	55.4
1346			10	0	1.85	-	4.8	-
1346				5	3.7	1.35	-	-
1347	62			10	6.9	1.05	0.9	13.9
1348				15	28	.78	-	-
1349				20	650	.59	1.3	22.6
1350				25	28	.45	-	-
1351				30	10.0	.32	1.3	39.2
1351				40	1.45	-	3.0	41.8
1358	60		3	0	12.5	-	7.0	-
1400				5	20	8.2	-	-
1401				10	30	7.4	1.3	17.8
1402				15	75	5.8	-	-
1404	59			20	430	4.5	1.3	28.8
1405				25	400	3.7	-	-
1407				30	67	2.7	1.3	37.0
1408				40	19.5	2.1	1.7	42.2
1409	58			45	13.0	1.55	1.7	49.5
1411				50	7.4	.92	5.2	46.1
1412				60	.90	-	17.4	45.3
1413				70	.37	-	27.0	-
1420	56	575	1	180	1.70			
1420		547			7.4			
1420		533			13.0			
1421		513			15.0			
1421		465			12.0			
1430	54	465			12.0			

Table 8.1.4. Station D2, July 7, 1971 (cont.)

Solar time	***h*** °	λ nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
1432	54	465	5	180	9.5			
1432		513			12.5			
1432		533			9.5			
1433		547			5.4			
1433		575			1.10			
1434		575	10	180	.77			
1434		547			4.0			
1434		533			7.8			
1434		513			10.5			
1435		465			8.2			
1437	53	465	20	180	4.9			
1437		513			6.1			
1437		533			4.2			
1437		547			2.1			
1437		575			.34			
1439		547	30	180	1.15			
1439		533			2.3			
1439		513			3.7			
1439		465			2.9			
1440		465	40	180	1.50			
1440		513			1.80			
1441		533			1.05			
1441		547			.53			
1442	52	533	50	180	.47			
1442		513			.87			
1442		465			.67			
1443		465	60	180	.30			
1444		513		180	.42			
1444		513		0	48			
1445		513	70	0	26			
1445		533			14.5			
1445		547			6.3			
1446		575			.48			
1446		547			6.3			
1446		533			15.0			
1447		513			28			
1447	51	465			17.0			
1448		465	80	0	7.4			
1448		513			12.5			
1448		533			6.6			
1448		547			2.9			

Table 8.1.4. Station D2, July 7, 1971 (cont.)

Solar time	***h*** °	**λ** nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
1449	51	547	90	0	1.40			
1449		533			3.4			
1449		513			6.9			
1450		465			3.7			
1451	50	465	100	0	2.4			
1451		513			4.4			
1451		533			1.85			
1451		547			.73			
1457	49	547	110	0	.34			
1457		533			.98			
1457		513			2.7			
1457		465			1.65			
1458		465	120	0	1.20			
1458		513			1.80			
1458		533			.55			
1459		513	150	0	.49			
1459		465			.36			
1512	46	513	150	0	.49			
1512			140		.84			
1512			130		1.20			
1512			120		1.70			
1512			110		2.6			
1513		513	100	0	4.0			
1514		533			1.60			
1514		547			.95			
1514		533			1.65			
1514		513			4.0			
1514		465			2.4			
1515		513	100	0	4.0	-	1.7	-
1515				10	4.6	2.9	1.7	7.8
1516				20	5.4	2.1	3.0	12.6
1517	45			30	4.4	1.35	3.5	20.4
1517				40	2.8	.80	3.5	24.4
1518				50	1.45	.45	1.3	23.1
1518				60	.65	.26	1.3	30.0
1519				70	.28	-	2.7	35.7
1520		465	100	0	2.2	-	7.4	-
1521				10	2.9	1.80	0.9	11.3
1522	44			20	2.8	1.25	0.9	14.8
1523				30	2.5	.90	0.9	20.4
1524				40	1.55	.49	3.5	26.1
1525				50	.77	.30	5.2	35.7

Table 8.1.4. Station D2, July 7, 1971 (cont.)

Solar time	h °	λ nm	**Depth** m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1526	44	465	100	60	.34	-	-	10.5
1527		465	90	0	3.6			
1527		513			6.1			
1527		533			2.8			
1527		547			1.10			
1528	43	547	80	0	2.1			
1528		533			5.1			
1528		513			10.0			
1528		465			5.8			
1530		547	70	0	4.8			
1530		533			11.0			
1530	43	575			.34			
1530		547			4.9			
1531		533			11.0			
1531		513			20			
1531		465			13.0			
1532		465	60	0	26			
1532		513			36			
1533		533			20			
1533		547			10.0			
1533		575			.90			
1535	42	575	50	0	2.1			
1535		547			17.0			
1535		533			34			
1535		513			54			
1535		465			36			
1536		465	40	0	67			
1536		513			105			
1536		533			75			
1537		547			38			
1537		575			5.4			
1538	41	575	30	0	10.0			
1538		547			61			
1538		533			105			
1538		513			125			
1539		465			75			
1540		465	20	0	115			
1540		513			145			
1540		533			130			
1540		547			115			
1541		575			29			
1541		599			1.20			

Table 8.1.4. Station D2, July 7, 1971 (cont.)

Solar time	***h*** °	λ nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
1542	41	599	10	0	4.0			
1542		575			38			
1542		547			130			
1542		533			200			
1543		513			185			
1543		465			110			
1543		628			.37			
1544	40	628	5	0	2.5			
1544		648			.98			
1544		465			150			
1544		513			320			
1544		533			400			
1544		547			260			
1544		575			92			
1544		599			15.0			
1545		599	1	0	40			
1545		575			125			
1545		547			320			
1545		533			470			
1545		513			400			
1545		465			185			
1545		648			5.5			
		628			13.0			
1549	39	628			14.0			
1549		465			180			
1549		513			390			
1549		533			480			
1549		547			310			
1549		575			125			
1549		599			41			

Table 8.1.5. Station D2, July 8, 1971

Solar time	h °	λ nm	Depth m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1040	67	474	1	0	170	-	-	-
1046	68			5	330	160	1.4	6.5
1048				10	560	140	1.7	9.5
1049				20	560	70	2.7	18.3
1050				25	280	58	1.7	24.7
1051				15	2800	97	2.7	13.5
1052	69			30	210	49	1.9	31.6
1053				35	140	45	3.9	36.0
1054				40	130	41	7.3	37.3
1055				45	90	35	12.3	36.8
1101	70			0	135	-	4.1	-
1102				50	11.5	9.5	35.4	48.7
1102				60	9.5	7.6	44.9	55.9
1103				70	8.9	7.6	52.9	61.9
1104				80	9.9	7.9	57.7	63.5
1106				90	9.5	8.3	60.4	60.1
1107	71			110	7.5	7.1	56.2	34.7
1108				130	5.8	6.1	41.9	16.7
1110				150	5.2	5.7	21.3	4.5
1111				180	5.2	-	1.5	-
1118	72		5	0	200	-	6.0	-
1119				5	740	145	3.2	6.0
1120				10	4000	105	5.6	9.2
1122				15	1600	82	6.4	12.0
1124				0	280	-	5.2	-
1128	73			10	2800	140	5.2	8.8
1129				8	1400	145	5.6	8.8
1130				12	2100 0	120	2.8	11.6
1131				15	1050	110	6.0	12.0
1132				20	380	105	4.0	15.6
1133				25	240	70	4.4	22.0
1134				30	160	56	5.6	31.2
1135				35	140	49	7.2	39.2
1136				40	98	38	11.2	24.0
1137	74			45	82	32	13.2	28.0
1139				50	26	13.0	22.0	36.0
1140				60	16.0	8.4	32.0	42.0
1142				70	13.0	7.9	44.0	54.0
1143				80	12.0	7.9	48.0	55.0
1145				90	11.0	7.9	53.2	49.2
1147				110	7.1	6.6	52.0	38.0
1149				130	5.5	4.8	27.0	24.0
1150				150	5.3	4.8	14.0	12.0
1151				180	4.8	-	5.2	-
1152			10	180	3.9	-	1.9	-
1153				150	4.0	4.2	23.6	7.2
1154				130	4.5	4.7	42.9	22.7
1156				110	6.1	5.7	52.2	40.0

Table 8.1.5. Station D2, July 8, 1971 (cont.)

Solar time	***h*** °	λ nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
1157	74	474	10	90	10.0	7.9	52.5	55.7
1158				80	12.5	8.8	44.4	55.9
1200				70	15.5	10.0	38.4	50.6
1202				60	20	11.5	31.8	43.5
1203				50	35	18.0	14.5	37.4
1205				45	64	31	10.9	37.4
1206				40	84	33	7.9	36.4
1210				35	120	36	5.6	31.4
1213				30	160	41	3.2	25.4
1214				25	275	47	0.3	19.4
1215				20	780	59	2.3	14.8
1218				15	270000	79	-	11.0
1220				10	2100	110	-	7.6
1221				5	500	155	2.3	4.6
1222				0	250	-	1.8	-
1225			15	0	210	-	4.0	-
1226	73			5	560	160	2.8	7.2
1228				10	2100	120	4.4	11.6
1229				13	250000	101	4.0	14.0
1230				15	3500	90	4.0	16.0
1231				20	760	83	4.0	-
1232				25	345	47	4.4	20.0
1234				30	185	40	4.8	26.4
1235				35	130	37	6.0	31.0
1236	72			40	92	26	9.2	32.0
1237				45	58	26	11.2	36.0
1238				50	40	16.0	14.8	34.0
1239				60	25	12.0	25.2	42.0
1240				70	18.5	10.5	32.8	48.0
1241				80	13.0	9.2	39.2	54.0
1242				90	10.5	7.4	44.0	50.0
1244				110	5.3	4.8	52.0	32.8
1245				130	4.2	3.7	20.8	-
1246	71			150	4.0	3.7	4.0	-
1247				180	3.4	-	4.4	-
1250			25	0	160	-	1.0	-
1251				5	270	110	1.3	5.0
1252				10	540	81	-	9.0
1253				15	85000	63	-	13.3
1255	70			20	1550	48	-	17.3
1256				30	200	33	0.0	29.3
1257				40	97	23	4.5	36.9
1258				50	47	14.0	9.0	37.8
1300				60	25	9.5	15.6	44.7
1300				70	16.5	7.6	22.9	49.7
1301				25	390	39	1.9	22.3
1302	69			80	11.5	6.0	30.2	51.3
1304				90	7.5	4.7	37.5	50.1

Table 8.1.5. Station D2, July 8, 1971 (cont.)

Solar time	h °	λ nm	Depth m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1305	69	474	25	110	3.7	3.0	48.2	30.9
1306				130	2.4	2.4	43.3	13.8
1307				150	2.0	2.1	26.8	3.3
1307				180	1.95	-	2.7	-
1308			50	180	.36	-	1.7	-
1309	68			150	.36	.41	22.2	3.3
1310				130	.46	.47	37.8	11.8
1312				110	.77	.61	43.6	30.6
1314				90	1.75	1.10	30.7	43.5
1316	67			80	3.1	1.50	23.0	43.4
1318				70	5.4	2.2	16.2	41.2
1320				60	10.0	3.3	10.7	38.2
1323	66			50	18.5	4.8	6.6	33.9
1324				40	34	7.2	3.1	28.5
1325				30	71	10.0	0.0	22.0
1326				25	150	12.0	1.0	18.6
1328	65			20	540	14.0	-	14.8
1330				15	135	17.0	-	11.5
1331				10	76	21	1.0	8.5
1333				0	36	-	3.0	-
1341	63		100	0	1.85	-	2.5	-
1342				10	2.4	1.25	1.4	7.5
1343				15	2.5	1.00	-	9.9
1344				20	2.5	.79	-	12.2
1345				25	2.1	.63	-	14.4
1346	62			30	1.60	.49	1.7	16.7
1347				40	.83	.29	2.1	21.3
1348				50	.40	.175	5.9	26.5
1349				60	.190	.093	10.2	32.1
1350				70	.095	.055	16.8	38.4
1351				80	.050	.036	28.7	44.2
1352	61			90	.032	.025	40.1	46.5
1353				110	.018	.017	44.9	35.0
1354				130	.013	.015	31.3	17.0
1356				150	.012	.014	15.5	4.4
1358	60			180	.012	-	1.3	-
1403	59		150	180	.00165	-	0.7	-
1405				150	.00165	.00185	17.9	6.5
1407				130	.00175	.00195	33.3	19.4
1408				110	.0022	.0022	44.4	35.1
1409	58			90	.0036	.0033	41.5	44.4
1410				80	.0057	.0046	33.6	42.8
1411				70	.0105	.0069	22.9	37.6
1413				60	.0195	.0110	13.4	31.6
1414	57			50	.041	.0195	7.2	25.8
1415				40	.090	.037	2.9	21.1
1416				30	.175	.065	1.0	16.5

Table 8.1.5. Station D2, July 8, 1971 (cont.)

Solar time	***h*** °	**λ** nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
1417	57	474	150	20	.26	.105	-	11.8
1418				10	.28	.160	1.5	6.8
1420	56			0	.23	-	2.5	-
1436	53		190	0	.058	-	0.0	-
1437				10	.065	.042	2.0	7.0
1439				20	.057	.029	0.0	12.5
1440				30	.036	.0170	0.0	17.0
1441	52			40	.020	.0099	3.0	21.0
1442				50	.0093	.0054	7.0	27.5
1454	50			60	.0047	.0031	14.0	32.0
1456	49			70	.0025	.00185	24.0	37.5
1458				80	.00150	.00125	34.0	42.5
1459				90	.00100	.00091	40.0	43.5
1500				110	.00059	.00061	-	-
1501	48			130	.00048	.00050	-	-
1502				150	.00045	.00048	-	-
1503				180	.00045	-	-	-
1528	43		250	50	.00070	.00045	8.0	24.0
1529				40	.00135	.00088	5.0	20.0
1530				30	.0025	.00155	2.0	17.0
1531				20	.0041	.00025	0.0	13.0
1532	42			10	.0054	.0040	2.0	8.0
1534				0	.0053	-	3.0	-
1536			275	0	.0022	-	4.0	-
1539	41			10	.0022	.00160	-	8.0
1545	40			20	.00160	.00100	-	14.0
1548	39			30	.00092	.00061	-	18.0

Table 8.1.6. Station B2, July 10, 1971

Solar time	h °	λ nm	Depth m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
0607	15	474	1	0	40			
0607		454			24			
0607		428			18.5			
0607		405			6.3			
0607		428			18.5			
0607		454			25			
0607		474			37			
0607		488			12.0			
0608		502			24			
0609					25			
0610					26			
0655	24	405	1	0	10.5			
0655		428			30			
0655		454			37			
0656		474			61			
0656		488			22			
0656		502			40			
0837	44	474	1	0	132			
0838		488			39			
0838		502			84			
0838		454			73			
0838		428			56			
0839	45	405			19.0			
0839		428			53			
0839		454			74			
0839		474			105			
0839		488			40			
0840		502			81			
0932	55	502	25	0	125			
0932		488			63			
0932		474			185			
0932		454			105			
0932		428			66			
0933		405			23			
0934		428			72			
0936	56	454			120			
0937		474			210			
0937		488			76			
0937		502			145			
0938		502	50	0	47			
0938		488			18.0			
0938		474			63			
0938		454			26			
0938		428			9.2			
0939		405			1.75			
0939		428			9.0			

Table 8.1.6. Station B2, July 10, 1971 (cont.)

Solar time	***h*** °	λ nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
0939	56	454	50	0	23			
0940		474			55			
0940		488			16.0			
0940		502			40			
1005	61	502	25	180	2.2	-		
1007				150	2.5	2.4		
1011	62			130	3.1	2.8		
1012				110	5.0	3.3		
1013	63			90	9.8	5.0		
1014				80	16.0	6.6		
1015				70	26	8.4		
1018				60	48	10.5		
1019	64			50	92	16.0		
1020				40	210	26		
1021				30	550	34		
1022				25	3200	53		
1023				20	10500	80		
1026	65			15	3800	100		
1027				10	630	125		
1028				0	280	-		
1028		488	25	0	130			
1028		474			440			
1029		454			240			
1029		428			140			
1029		405			42			
1030		488	25	0	140	-		
1030				10	290	66		
1031	66			15	900	49		
1032				20	3500	39		
1033				25	800	24		
1034				30	220	21		
1037	67			40	74	17.0		
1038				50	37	10.5		
1039				60	20	7.7		
1040				70	12.0	5.5		
1041				80	7.9	4.1		
1042				90	4.8	3.0		
1043	68			110	2.4	1.85		
1044				130	1.60	1.45		
1045				150	1.35	1.25		
1047				180	1.25	-		
1048		474	25	180	4.0	-		
1049	69			150	4.4	4.1		
1050				130	5.0	4.6		
1051	69			110	7.7	6.1		
1052				90	16.0	9.0		

Table 8.1.6. Station B2, July 10, 1971 (cont.)

Solar time	*h* °	λ nm	Depth m	*θ* °	*L*(*θ*+)	*L*(*θ*-)	*P*(*θ*+) %	*P*(*θ*-) %
1054	69	474	25	80	24	12.0		
1055				70	40	18.5		
1056	70			60	63	24		
1057				50	120	37		
1057				40	240	53		
1058				30	530	69		
1059				25	1050	95		
1100				20	6600	160		
1102				15	7900	185		
1103	71			10	6600	240		
1104				5	790	340		
1105				0	530	-		
1106		454	25	0	240	-		
1108				10	2100	160		
1109				15	9700	100		
1110				20	4900	81		
1111	72			25	490	54		
1112				30	240	38		
1114				40	120	30		
1115				50	55	20		
1116				60	28	12.0		
1117				70	19.0	9.4		
1118				80	11.5	6.5		
1119	73			90	7.4	4.6		
1120				110	3.9	2.9		
1121				130	2.6	2.3		
1122				150	2.3	2.1		
1124				180	2.1	-		
1125		428	25	180	1.15	-		
1126				150	1.35	1.25		
1127				130	1.60	1.35		
1128				110	2.1	1.75		
1129	74			90	4.1	2.8		
1130				80	6.6	4.0		
1131				70	10.5	5.8		
1132				60	18.5	8.7		
1133				50	30	13.0		
1134				40	54	22		
1136				30	140	31		
1138				25	300	46		
1139				20	450	70		
1140				15	1550	82		
1140				10	1750	110		
1141				0	280	-		
1142		405	25	0	68	-		
1143				10	500	33		
1144	75			15	830	24		

Table 8.1.6. Station B2, July 10, 1971 (cont.)

Solar time	h °	λ nm	Depth m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1144	75	405	25	20	145	19.0		
1145				25	65	16.5		
1146				30	35	10.0		
1148				40	16.0	6.6		
1149				50	9.0	4.1		
1150				60	4.8	2.6		
1151				70	3.3	1.75		
1152				80	1.85	1.20		
1153				90	1.15	.82		
1154				110	.61	.48		
1155				130	.42	.36		
1156				150	.37	.32		
1157				180	.32	-		
1214		405	50	0	4.5	-		
1215				180	.0125	-		
1217	74			130	.0155	.0145		
1218				150	.0135	.0128		
1219				110	.026	.022		
1220				90	.064	.042		
1220				80	.108	.065		
1221				70	.185	.104		
1222				60	.35	.180		
1223				50	.61	.29		
1223				40	1.13	.48		
1224				35	1.65	.62		
1224				30	2.3	.80		
1225				25	3.3	1.10		
1227				20	4.8	1.50		
1228				15	5.5	1.85		
1229				10	5.0	2.5		
1230				0	3.4	-		
1234	73	428	50	0	16.0	-		
1236				10	30	10.5		
1237				15	29	7.9		
1238				21	18.0	6.2		
1239				25	14.5	4.5		
1240				30	9.5	3.4		
1241				40	5.5	2.2		
1242	72			50	3.3	1.40		
1243				60	1.65	.83		
1245				70	.90	.50		
1246				80	.49	.30		
1247				90	.28	.185		
1247				110	.115	.100		
1248				130	.080	.075		
1249				150	.066	.064		
1250	71			180	.061	-		

Table 8.1.6. Station B2, July 10, 1971 (cont.)

Solar time	h °	λ nm	**Depth** m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1251	71	454	50	180	.175	-		
1252				150	.195	.185		
1253				130	.24	.23		
1254				110	.36	.30		
1255				90	.89	.57		
1256				80	1.60	.85		
1257				70	2.7	1.30		
1258	70			60	5.0	2.3		
1259				50	9.0	3.4		
1301				40	15.5	4.8		
1302				35	20	6.3		
1302				30	29	7.4		
1303				25	36	9.0		
1304				20	49	11.0		
1305	69			15	66	13.0		
1306				10	58	16.5		
1307				0	30	-		
1307		474	50	0	79	-		
1308				10	135	44		
1308				15	160	34		
1309				20	105	26		
1310				25	82	20		
1311				30	69	16.0		
1312	68			40	36	11.5		
1313				50	21	7.4		
1314				60	13.0	4.5		
1315				70	6.8	3.0		
1317				80	3.8	1.90		
1318	67			90	2.3	1.30		
1319				110	.92	.72		
1320				130	.54	.52		
1320				150	.41	.41		
1321				180	.375	-		
1322		488	50	180	.110	-		
1323				150	.113	.110		
1324	66			130	.128	.122		
1325				110	.22	.185		
1326				90	.55	.34		
1327				80	1.00	.54		
1329				71	1.75	.72		
1330	65			60	3.6	1.15		
1332				50	6.0	2.1		
1334				40	10.0	2.9		
1335				30	19.0	4.6		
1336	64			25	25	4.8		
1337				20	34	6.1		
1338				15	34	7.1		
1339				10	26	9.0		

Table 8.1.6. Station B2, July 10, 1971 (cont.)

Solar time	*h* °	λ nm	Depth m	*θ* °	*L*(*θ*+)	*L*(*θ*-)	*P*(*θ*+) %	*P*(*θ*-) %
1341	64	488	50	0	15.0	-		
1347	63	502	50	0	36	-		
1347				10	59	21		
1348	62			15	79	20		
1349				20	98	14.5		
1350				25	63	12.5		
1351				30	53	9.8		
1352				40	29	6.1		
1353	61			50	15.5	3.8		
1355				60	8.2	2.6		
1357				70	4.5	1.60		
1358				80	2.5	1.05		
1359	60			90	1.30	.72		
1359				110	.50	.36		
1400				130	.27	.27		
1401				150	.21	.21		
1402				180	.190	-		

Table 8.1.7. Station A2, July 12, 1971

Solar time	h °	λ nm	Depth m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1651	26	502	25	0	10.5	-	13.5	-
1652				10	14.5	7.5	2.2	22.2
1654				20	18.0	5.3	1.7	28.2
1655				25	19.5	4.5	-	-
1656	25			30	19.5	3.5	2.6	30.8
1657				35	19.5	3.1	-	-
1658				40	18.0	2.7	2.2	31.4
1659				45	13.5	2.3	1.7	30.4
1700				50	11.5	1.85	1.3	33.5
1701	24			60	5.5	1.05	3.0	37.8
1702				70	2.8	.74	6.5	39.6
1704				80	1.20	.43	10.0	36.6
1706	23			90	.64	.28	13.5	32.2
1707				110	.24	.150	29.6	20.4
1709				130	.120	.095	34.8	9.1
1710				150	.084	.076	29.6	3.0
1711	22			180	.071	-	9.1	-
1713		474	25	180	.063	-	10.9	-
1714				150	.074	.065	31.4	4.8
1715				130	.095	.079	37.4	12.4
1716	21			110	.165	.115	35.2	23.9
1717				90	.45	.21	20.9	35.6
1718				80	.81	.31	13.5	36.1
1719				70	1.70	.50	6.5	34.8
1720				60	4.2	.90	2.2	31.3
1721	20			50	6.8	1.50	3.5	34.0
1724				45	8.4	1.65	3.9	34.0
1726	19			40	9.4	1.65	3.5	33.5
1728				35	10.5	2.1	-	-
1729				30	10.5	2.5	1.7	31.4
1731	18			25	10.5	2.9	-	-
1733				20	9.9	3.5	6.1	28.3
1735				10	8.1	5.5	11.3	24.4
1736				0	6.8	-	18.3	-
1737	17	454	25	0	3.1	-	21.3	-
1739				10	3.6	2.5	9.6	28.3
1741				20	3.8	1.65	4.4	33.5
1742	16			25	3.5	1.40	-	-
1744				30	3.3	1.10	2.6	36.1
1745				35	2.5	.81	-	-
1746				40	2.7	.70	1.7	34.0
1747	15			45	2.2	.57	1.3	29.6
1749				50	1.50	.43	1.3	33.0
1750				60	.77	.25	1.3	40.5
1751				70	.34	.130	2.2	43.5
1752	14			80	.165	.081	9.6	43.0
1753				90	.095	.052	17.0	40.0
1754				110	.037	.027	30.4	29.6

Table 8.1.7. Station A2, July 12, 1971 (cont.)

Solar time	***h*** °	**λ** nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
1754	14	454	25	130	.023	.018	39.6	12.6
1755				150	.017	.015	35.6	7.4
1756				180	.014	-	19.1	-
1759	13	428	25	90	.029	.017	11.7	44.4
1800				80	.048	.029	7.0	40.0
1801				70	.084	.045	2.2	37.4
1802	12			60	.165	.081	1.3	34.0
1803				50	.36	.145	2.2	30.9
1804				45	.42	.175	3.5	33.5
1805				40	.52	.24	5.2	35.6
1806				35	.64	.26	-	-
1807				30	.74	.30	8.7	38.7
1808	11			25	.85	.41	-	-
1809				20	.85	.38	13.9	39.6
1810				10	.95	.70	22.6	36.1
1811				0	.81	-	32.2	-
1813	10	405	25	0	.21	-	27.0	-
1814				10	.22	.175	-	-
1815				20	.195	.130	16.5	44.8
1816				25	.165	.095	-	-
1817				30	.145	.088	8.3	45.2
1818				35	.115	.071	-	-
1819	9			40	.084	.051	5.2	36.6
1820				45	.065	.036	4.4	43.1
1821				50	.050	.028	3.5	44.4
1822				60	.026	.014	3.5	45.2
1823		502	25	180	.021	-	15.2	-
1824	8			150	.023	.021	31.8	6.1
1826				130	.029	.026	36.1	8.3
1827				110	.048	.038	34.0	15.7
1828				90	.115	.073	7.8	34.0
1828				80	.195	.120	3.5	35.7
1829	7			70	.34	.185	2.6	35.7
1830				60	.64	.32	4.8	34.0
1831				50	1.10	.52	7.4	30.8
1832				45	1.35	.61	8.7	28.7
1833				40	1.70	.77	10.0	32.6
1834				30	2.2	.90	13.5	37.0
1835	6			20	2.5	1.30	19.6	39.1
1836				10	2.5	1.60	27.8	39.1
1836				0	2.1	-	37.0	-
1837		474	25	0	2.1	-	35.2	-
1838				10	2.5	1.60	29.2	42.2
1839				20	2.3	1.20	22.2	44.8
1840	5			30	1.70	.81	17.8	40.5
1841				40	1.10	.61	14.8	33.5

Table 8.1.7. Station A2, July 12, 1971 (cont.)

Solar time	***h*** °	**λ** nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
1842	5	474	25	45	.85	.43	13.0	29.6
1843				50	.57	.32	11.8	30.8
1844				60	.28	.180	8.7	33.5
1845				70	.21	.095	5.7	36.5
1846	4			80	.073	.050	3.5	39.2
1847				90	.043	.029	11.8	39.6
1848				110	.019	.013	41.1	15.2
1849				130	.011	-	45.2	10.4
1850		454	25	90	.014	-	7.8	45.2
1850				80	.024	.016	6.1	45.7
1851				70	.042	.028	8.7	44.8
1852	3			60	.073	.050	12.2	42.1
1853				50	.125	.084	15.7	38.7
1854				45	.180	.115	17.4	33.5
1855				40	.22	.135	19.6	37.0
1856				30	.31	.175	24.4	43.5
1857				20	.40	.23	30.4	48.7
1858	2			10	.41	.35	38.3	51.7
1858				0	.38	-	45.2	-
1859		428	25	0	.175	-	46.6	-
1900				10	.175	.130	36.1	49.6
1901				20	.145	.095	25.6	50.4
1902				30	.105	.071	20.8	48.6
1903	0			40	.068	.042	16.1	42.6
1904				50	.037	.023	11.7	33.5
1904				60	.017	.011	7.0	45.2

Table 8.1.8. Station A2, July 13, 1971

Solar time	h °	λ nm	Depth m	θ °	$L(\theta+)$	$L(\theta-)$	$P(\theta+)$ %	$P(\theta-)$ %
1010	62	474	50	0	29	-	-	-
1011	63			5	34	25	-	-
1012				10	40	21	-	3.0
1013				15	44	18.0	-	-
1014				20	44	13.0	-	6.5
1015				30	28	9.1	-	10.0
1016				40	18.0	6.0	0.0	15.2
1017	64			50	9.4	3.8	2.6	20.2
1018				60	5.0	2.4	7.0	22.6
1019				70	2.9	1.45	12.2	29.2
1020				80	1.45	.90	20.0	33.0
1020				90	.85	.61	27.0	37.6
1021				110	.40	.34	38.2	27.4
1022	65			130	.27	.25	30.5	18.8
1023				150	.24	.22	16.1	2.6
1023				180	.21	-	1.7	-
1024		428	50	180	.019	-	7.8	-
1025				150	.021	.019	23.5	4.8
1026				130	.024	.021	36.6	14.8
1027				110	.033	.028	47.0	31.8
1028	66			90	.068	.048	31.3	43.1
1029				80	.115	.072	23.9	35.7
1030				70	.21	.120	15.3	29.2
1030				60	.40	.21	10.0	23.0
1031				50	.85	.38	4.8	17.8
1032				40	1.70	.67	2.2	13.0
1033	67			30	3.2	1.15	0.0	9.6
1034				20	4.4	1.80	0.0	6.5
1035				10	5.0	2.7	-	3.9
1035				0	3.9	-	0.9	-
1041	68	428	100	0	.079	-	-	-
1042				10	.087	.058	-	-
1042				20	.068	.039	-	-
1043				30	.045	.026	-	-
1044				40	.024	.014	-	-
1045	69			45	.016	-	-	-
1046		474	100	0	2.5	-	-	-
1046				10	2.9	1.80	-	1.3
1047				20	2.5	1.35	-	4.4
1048				30	1.50	.85	0.0	7.0
1049				40	.90	.54	2.2	10.9
1050				50	.47	.31	7.0	16.1
1051	70			60	.25	.175	11.8	22.6
1051				70	.140	.105	19.1	29.2
1052				80	.081	.063	26.6	38.3
1053				90	.055	.046	33.5	44.8
1054				110	.032	.028	37.9	30.4

Table 8.1.8. Station A2, July 13, 1971 (cont.)

Solar time	***h*** °	**λ** nm	**Depth** m	***θ*** °	***L*(*θ*+)**	***L*(*θ*-)**	***P*(*θ*+)** %	***P*(*θ*-)** %
1055	70	474	100	130	.024	.022	29.2	17.0
1056				150	.021	.019	13.9	3.5
1056				180	.016	-	6.1	-

Table 8.2.1. **E_u, E_{ou}, μ_u, and Q calculated from upward radiance**

Date /Stat.	Solar time	h °	λ nm	Depth m	E_u	E_{ou}	μ_u	Q
6.26	1502-08	49-47	465	0.5	27.0	62.9	.430	4.10
/J1	1509-12	47		5	19.2	47.6	.404	3.49
	1541-44	41		15	14.4	37.3	.386	4.24
	1545-49	40		25	9.07	24.0	.378	4.32
	1611-15	35		50	1.75	4.96	.353	4.38
	1618-22	34-33		100	.068	.167	.408	3.58
7.2	1225-30	74-73	465	1	39.5	87.4	.452	3.40
/J2A	1235-39	73-72		5	33.4	76.0	.440	3.62
	1319-24	67-66		10	27.4	63.3	.432	3.84
	1325-29	66		15	20.7	49.1	.423	3.74
	1402-08	60-59		25	10.8	26.5	.408	3.90
	1410-16	58-57		50	1.54	3.82	.402	3.88
	1457-01	49		5	29.6	69.9	.423	3.74
	1536-40	42-41		5	29.0	73.7	.422	4.22
	1624-28	33-32		5	23.0	62.5	.394	4.24
	1712-15	23		5	18.1	48.8	.371	4.57
	1824-29	10-9		5	3.37	8.94	.377	4.56
7.6	1516-20	46-45	465	5	32.0	76.0	.421	3.57
/E2	1544-49	40-39		5	30.2	73.8	.409	4.23
	1602-07	37-36		15	12.7	27.0	.470	3.32
	1713-20	23-22		5	16.8	45.9	.365	5.08
7.7	0705-10	26-27	465	1	20.3	49.0	.414	3.94
/D2	0712-17	28-29		5	17.8	44.2	.402	4.21
	0747-51	35		10	20.3	49.9	.407	4.27
	0752-57	36		15	17.5	44.2	.395	4.13
	0821-25	41-42		25	12.9	32.8	.391	4.24
	0827-30	42-43		50	1.91	4.88	.391	4.02
	0914-20	51-53		50	2.77	6.81	.406	3.88
	0925-33	54-55		25	16.7	40.9	.409	3.96
	1014-26	63-65		15	29.7	68.4	.434	4.89
	1027-34	65-66		5	38.2	84.6	.451	3.36
7.8	1106-11	70-71	474	1	19.1	42.3	.452	3.68
/D2	1145-51	74		5	17.6	39.8	.441	3.66
	1152-57	74		10	14.9	34.8	.429	3.82
	1242-47	72-71		15	13.3	31.2	.425	3.90
	1304-07	69		25	7.90	19.7	.402	4.05
	1308-14	69-68		50	1.55	4.07	.381	4.31
	1352-58	61-60		100	.046	.106	.430	3.81
	1403-09	59-58		150	.0060	.0136	.441	3.63
	1459-03	49-48		190	.00161	.0037	.437	3.57
7.10	1005-13	61-63	502	25	9.55	23.7	.403	4.34
/B2	1042-47	67-68	488	25	5.01	12.5	.402	4.01
	1048-52	68-69	474	25	16.2	40.2	.403	4.05
	1119-24	73	454	25	8.18	20.0	.410	3.90
	1125-29	73-74	428	25	4.78	11.6	.413	4.16

Table 8.2.1. E_u, E_{ou}, μ_u, and Q calculated from upward radiance (cont.)

Date /Stat.	Solar time	h °	λ nm	Depth m	E_u	E_{ou}	μ_u	Q
7.10	1153-57	75	405	25	1.30	3.21	.404	4.06
/B2	1215-20	75-74	405	50	.053	.143	.371	4.24
	1247-50	72-71	428	50	.254	.659	.385	4.16
	1251-55	71	454	50	.762	2.01	.379	4.36
	1318-21	67	474	50	1.76	4.79	.367	4.69
	1322-26	67-66	488	50	.447	1.20	.372	4.06
	1359-02	60	502	50	.908	2.53	.358	4.78
7.12	1706-11	23-22	502	25	.374	1.09	.344	5.26
/A2	1713-17	22-21	474	25	.296	.819	.361	4.69
	1753-56	14	454	25	.068	.188	.362	4.87
	1823-28	9-8	502	25	.093	.253	.367	4.42
7.13	1020-23	64-65	474	50	.875	2.22	.394	4.17
/A2	1024-28	65-66	428	50	.075	.184	.404	3.92
	1053-56	70	474	100	.074	.178	.415	4.62

Table 8.2.2. E_d, E_{od}, and μ_d calculated from downward radiance

Date /Stat.	Solar time	h °	λ nm	Depth m	E_d	E_{od}	μ_d
6.26	1442-02	52-49	465	0.5	268	362	.739
/J1	1512-29	47-43		5	326	454	.718
	1530-41	43-41		15	385	514	.749
	1549-59	40-38		25	240	329	.729
	1600-11	37-35		50	76.2	104	.730
	1622-33	33-31		100	2.67	3.45	.774
7.2	1206-25	74	465	1	288	370	.776
/J2A	1239-55	72-71		5	616	723	.853
	1305-19	69-67		10	552	666	.828
	1329-42	66-63		15	583	708	.824
	1343-02	63-60		25	442	534	.828
	1416-28	57-55		50	67.1	84.2	.796
	1444-57	52-49		5	383	500	.767
	1523-36	44-42		5	469	642	.730
	1553-06	39-36		50	55.4	75.7	.733
	1610-24	35-33		5	530	728	.728
	1635-49	30-28		50	37.3	51.0	.732
	1652-12	27-23		5	404	576	.701
	1722-34	21-19		50	27.6	40.3	.648
	1740-05	18-13		50	21.0	29.5	.713
	1810-18	12-11		25	63.9	92.7	.689
	1829-41	9-7		5	70.8	102	.694
	1843-56	6-4		25	23.2	31.9	.729
	1902-11	3-2		5	25.2	33.2	.759
7.6	1520-31	45-43	465	5	441	592	.746
/E2	1532-44	43-40		5	582	768	.758
	1607-19	36-33		15	381	537	.709
	1627-39	32-29		50	51.7	70.7	.731
	1700-13	26-23		5	450	640	.704
7.7	0648-05	23-26	465	1	398	533	.748
/D2	0717-33	29-32		5	426	554	.769
	0735-47	32-35		10	453	606	.746
	0757-09	36-39		15	477	622	.768
	0810-21	39-41		25	336	450	.746
	0830-41	43-45		50	84.3	108	.781
	0859-14	49-51		50	101	131	.772
	0933-54	55-59		25	474	586	.809
	0955-14	59-63		15	656	802	.819
	1034-50	66-68		5	451	559	.806
7.8	1040-06	67-70	474	1	262	317	.828
/D2	1118-45	72-74		5	373	433	.862
	1157-22	74		10	266	325	.818
	1225-42	74-72		15	303	365	.830
	1250-04	71-69		25	432	493	.876
	1314-33	68-65		50	61.7	78.5	.786
	1341-52	63-61		100	1.77	2.20	.806

Table 8.2.2. E_d, E_{od}, and μ_d calculated from downward radiance (cont.)

Date **/Stat.**	**Solar** **time**	h °	λ nm	**Depth** m	E_d	E_{od}	μ_d
7.8	1409-20	58-56	474	150	.210	.259	.810
/D2	1436-59	53-49		190	.051	.064	.805
7.10	1013-28	63-65	502	25	471	558	.844
/B2	1030-42	65-67	488	25	194	237	.822
	1052-05	69-71	474	25	752	884	.850
	1106-19	71-73	454	25	436	506	.863
	1129-41	74	428	25	237	277	.853
	1142-53	74-75	405	25	72.7	84.7	.858
	1220-30	74	405	50	3.11	3.84	.809
	1234-47	73-72	428	50	14.3	17.7	.807
	1255-07	71-69	454	50	31.6	40.7	.777
	1307-18	69-67	474	50	74.3	95.3	.780
	1326-41	66-64	488	50	18.6	24.2	.769
	1347-59	63-60	502	50	45.4	58.5	.776
7.12	1651-06	26-23	502	25	17.6	23.9	.735
/A2	1717-36	21-18	474	25	11.0	15.3	.719
	1737-53	17-14	454	25	3.85	5.01	.768
	1759-11	13-11	428	25	1.01	1.33	.760
	1828-36	8-6	502	25	3.07	4.21	.729
	1837-47	6-4	474	25	2.40	3.07	.783
	1850-58	4-2	454	25	.488	.648	.753
7.13	1010-20	62-64	474	50	33.7	43.5	.775
/A2	1028-35	66-67	428	50	3.74	4.66	.803
	1046-53	69-70	474	100	2.40	3.03	.791

Table 8.2.3. *R* and μ_d/μ_u calculated from downward and upward radiance

Date /Stat.	Solar time	h °	λ nm	Depth m	R %	μ_d/μ_u
6.26	1442-08	52-49	465	0.5	10.1	1.72
/J1	1509-29	47-43		5	5.90	1.78
	1530-44	43-41		15	3.75	1.94
	1545-59	40-38		25	3.78	1.93
	1600-15	37-35		50	2.30	2.07
	1618-33	33-31		100	2.54	1.90
7.2	1206-30	74-73	465	1	13.7	1.72
/J2A	1235-55	73-71		5	5.42	1.94
	1305-24	69-66		10	4.96	1.91
	1325-42	66-63		15	3.56	1.95
	1343-08	63-59		25	2.45	2.03
	1410-28	58-55		50	2.29	1.98
	1444-01	52-49		5	7.72	1.81
	1523-40	44-41		5	6.18	1.86
	1610-28	35-32		5	4.65	1.85
	1652-15	27-23		5	4.49	1.89
	1824-41	10-7		5	4.76	1.84
7.6	1516-31	46-43	465	5	7.26	1.77
/E2	1532-49	43-39		5	5.19	1.85
	1602-19	37-33		15	3.34	1.51
	1700-20	26-22		5	3.73	1.93
7.7	0648-10	23-27	465	1	5.09	1.81
/D2	0712-33	28-32		5	4.18	1.91
	0735-51	32-35		10	4.49	1.83
	0752-09	36-39		15	3.66	1.94
	0810-25	39-42		25	3.83	1.91
	0827-41	42-45		50	2.27	2.00
	0859-20	49-53		50	2.74	1.90
	0925-54	54-59		25	3.53	1.98
	0955-26	59-65		15	4.52	1.89
	1027-50	65-68		5	8.46	1.79
7.8	1040-11	67-71	474	1	7.30	1.83
/D2	1118-51	72-74		5	4.71	1.95
	1152-22	74		10	5.61	1.91
	1225-47	74-71		15	4.38	1.95
	1250-07	71-69		25	1.83	2.18
	1308-33	69-65		50	2.51	2.06
	1341-58	63-60		100	2.58	1.87
	1403-20	59-56		150	2.85	1.84
	1436-03	53-48		190	3.14	1.84
7.10	1005-28	61-65	502	25	2.03	2.09
/B2	1030-47	65-68	488	25	2.58	2.05
	1048-05	68-71	474	25	2.15	2.11
	1106-24	71-73	454	25	1.88	2.11
	1125-41	73-74	428	25	2.02	2.07

Table 8.2.3. R and μ_d/μ_u calculated from downward and upward radiance (cont.)

Date **/Stat.**	**Solar** **time**	h °	λ nm	**Depth** m	R %	μ_d/μ_u
7.10	1142-57	74-75	405	25	1.79	2.12
/B2	1215-30	75-74	405	50	1.71	2.18
	1234-50	73-71	428	50	1.78	2.09
	1251-07	71-69	454	50	2.41	2.05
	1307-21	69-67	474	50	2.37	2.12
	1322-41	67-64	488	50	2.40	2.07
	1347-02	63-60	502	50	2.00	2.17
7.12	1651-11	26-22	502	25	2.13	2.13
/A2	1713-36	22-18	474	25	2.68	1.99
	1737-56	17-14	454	25	1.77	2.12
	1823-36	9-6	502	25	3.03	1.98
7.13	1010-23	62-65	474	50	2.60	1.97
/A2	1024-35	65.67	428	50	1.99	1.99
	1046-56	69-70	474	100	3.08	1.91

Table 8.3.1. Coefficients and their ratios calculated from radiance distribution

Date /Stat.	h °	λ nm	z_1-z_2 m	a m^{-1}	K_o m^{-1}	K_d m^{-1}	K_u m^{-1}	K_L m^{-1}	a/K_o	a/K_d	a/K_u	a/K_L	K_u/K_d	K_u/K_L
6.26	43-52	465	0.5-15	-	-	-	.044	.046	-	-	-	-	-	.95
/J1	38-43		15-25	.031	.045	.047	.046	.048	.70	.66	.68	.65	.98	.96
	35-40		25-50	.030	.047	.046	.066	.066	.64	.66	.46	.45	1.43	.99
	31-37		50-100	.046	.068	.067	.065	.061	.68	.69	.72	.75	.97	1.07
7.02	73-74	465	1-5	-	-	-	.042	.056	-	-	-	-	-	.75
/J2A	71-73		5-10	-	-	-	.040	.052	-	-	-	-	-	.76
	66-69		10-15	-	-	-	.056	.051	-	-	-	-	-	1.10
	59-66		15-25	.020	.030	.028	.065	.071	.67	.72	.31	.28	2.32	.91
	55-63		25-50	.057	.074	.075	.078	.076	.77	.76	.74	.75	1.04	1.02
7.07	59-68	465	5-15	-	-	-	.025	.063	-	-	-	-	-	.40
/D2	54-65		15-25	.023	.032	.035	.030	.037	.72	.66	.77	.62	.86	.81
	49-59		25-50	.044	.058	.055	.072	.071	.76	.80	.62	.62	1.31	1.01
7.08	67-74	474	1-5	-	-	-	.020	.020	-	-	-	-	-	1.02
/D2	72-74		5-10	-	-	-	.033	.042	-	-	-	-	-	.80
	71-74		10-15	-	-	-	.023	.027	-	-	-	-	-	.83
	69-74		15-25	-	-	-	.052	.056	-	-	-	-	-	.94
	65-71		25-50	.062	.073	.078	.065	.068	.85	.79	.95	.91	.83	.96
	60-69		50-100	.052	.072	.071	.070	.068	.73	.73	.74	.76	.99	1.04
	56-63		100-150	.032	.043	.043	.041	.040	.75	.75	.79	.80	.95	1.02
	48-59		150-190	.026	.035	.035	.033	.033	.75	.75	.80	.79	.94	1.01
7.10	74-75	405	25-50	.101	.124	.126	.128	.130	.81	.80	.79	.78	1.02	.99
/B2	71-74	428	25-50	.089	.110	.112	.117	.117	.81	.79	.76	.76	1.04	1.00
	69-73	454	25-50	.083	.100	.105	.095	.099	.82	.79	.87	.84	.90	.96
	67-71	474	25-50	.072	.089	.093	.089	.095	.80	.77	.81	.76	.96	.94
	64-68	488	25-50	.070	.091	.094	.097	.097	.76	.74	.72	.72	1.03	.99
	60-65	502	25-50	.072	.091	.094	.094	.098	.80	.77	.77	.73	1.00	.96