

can be employed in identifying the origin of modern marine salinity intrusion in groundwaters. Further, their absence accompanied by the presence of palmitoleic and oleic acids can be exploited to identify the palaeomarine intrusions. These findings are supported by *I/Cl* ratio as well as by radiocarbon ages.

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Availability of photosynthetically active radiation in Antarctica

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We report here the photosynthetically active radiation (PAR) variations at Antarctica (latitude 70°S)

for the year 1991. The variations in PAR are intense in Antarctica, because of its unique polar position and weather conditions. We present here the data on clear day PAR variations at Maitri station and inside the greenhouse at Maitri station, collected during the 10th Indian Scientific Expedition to Antarctica (1990-92) for one full year. The peak levels occurred at the local noon at 11 h (GMT). The peak level at Maitri station was 89.28 klux in December, followed by 86.17 klux in January. The PAR was zero in June and July. The peak level inside the greenhouse was 50 klux in December. The PAR levels were almost symmetric with respect to the mid-point of the year. The PAR decreases from January to June and then increases from August to December.

ANTARCTICA is an isolated glacial continent having an area of 14 million km². Only 2% of this area is free from ice. The region experiences the most adverse environmental conditions, the average temperature ranging from 0.4°C in summer to -40°C in winter. The Antarctic climate is characterized by strong blizzards, high albedo and six-month-long night and day with increased UV radiation. Antarctica receives lesser amounts of solar radiation because of its polar position; however, the daily total radiative energy received during summer at the south pole is about the same as that received in equatorial regions¹.

Increased scientific activity in the continent and the prolonged stay of scientists initiated experiments on growing plants for fresh food²⁻⁵. The studies on Antarctic flora and Polar Horticulture stimulated the collection of data on photosynthetically active radiation (PAR)⁶. The information presented here includes the clear-day averaged data collected during the 10th Indian Scientific Expedition to Antarctica.

The study was conducted at Maitri station (latitude 70°45'39.4", longitude 11°44'48.6"). Luxmeters and a

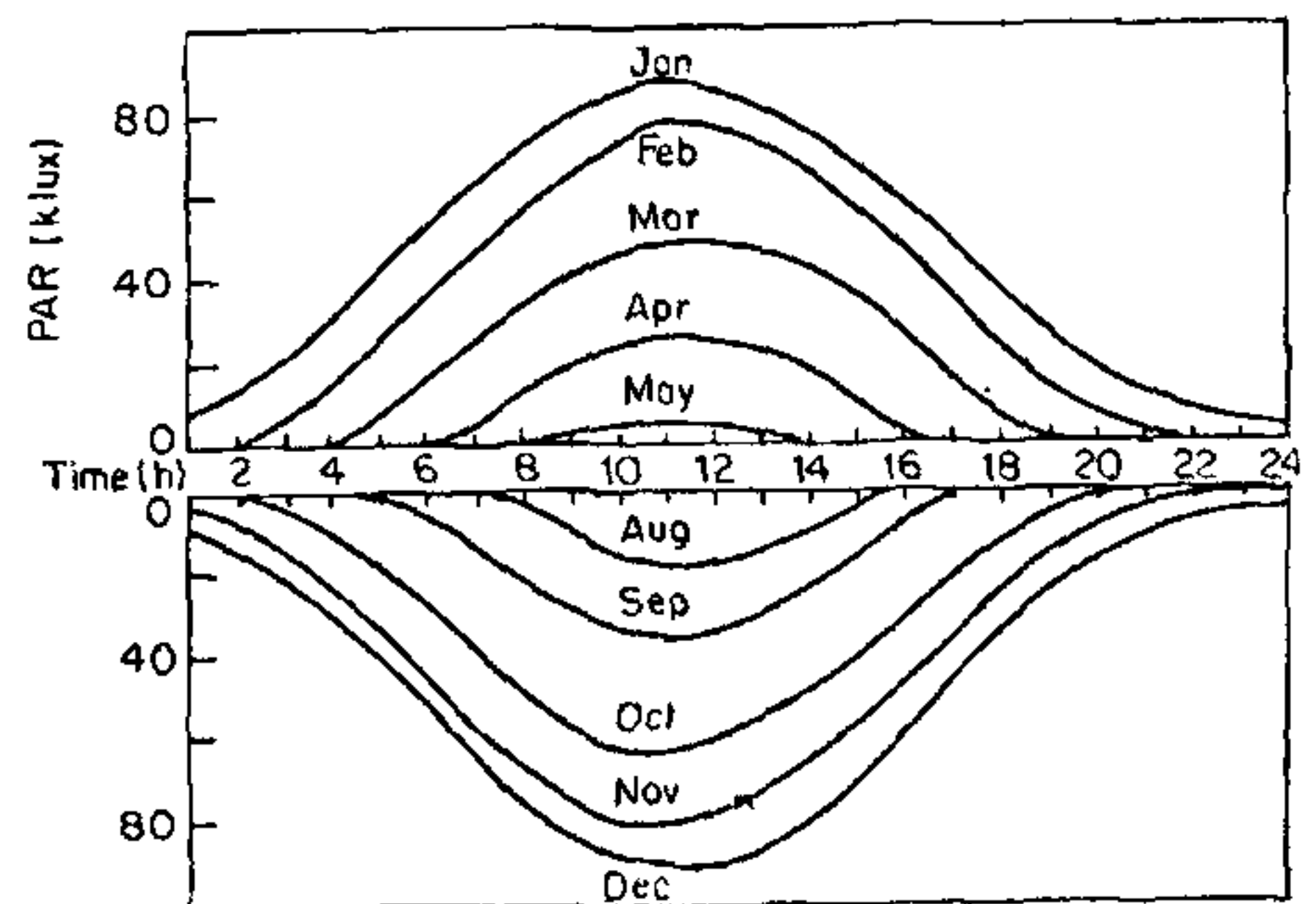


Figure 1. PAR in Antarctica (at Maitri station).

RESEARCH COMMUNICATIONS

pyranometer were employed for collecting data. The data were recorded at the local mean time (GMT) and represent the same. Hourly data for each day were recorded and averaged.

The PAR variations are presented in Figures 1 and 2. The daylength is highly variable and is shown in Figure 3. The daylength is 24 h in January and December. It is zero in June and July. Maximum PAR was received in January, December and November. Peak PAR levels were recorded at 11 h at local noon. The PAR levels varied with daylength, decreasing from January to June and then increasing from August to December. The peak PAR values were: 86.17 klux in January, 77.52 klux in February, 50.04 klux in March, 26.64 klux in April, 5.67 klux in May and 0 lux in June. For the second half of the year, the values were 0 lux in July, 17.54 klux in August, 35.82 klux in September, 61.7 klux in October, 79.88 klux in November and 89.28 klux in December. The dotted line in Figure 2 shows the actual PAR received in the greenhouse. After 9 h the PAR dropped to a low level of 5 klux or less. This was because of improper orientation of the greenhouse. If the greenhouse had been properly oriented the actual PAR received would be as shown in Figure 2.

The study was conducted keeping photosynthesis in view. The light or spectral quality (for morphogenesis in plants) will need further study. This is because the spectral composition of light changes with the ratio between direct and diffuse radiation. Diffuse radiation, percentually contains more short-wave radiation (i.e. green and blue) than does direct radiation⁷.

Kubin⁸ has discussed the limits of the photosynthetically active region of the spectrum and the basic problem of radiation measurement, evaluation in plant physiology and great significance of green light in highly productive photosynthetic systems.

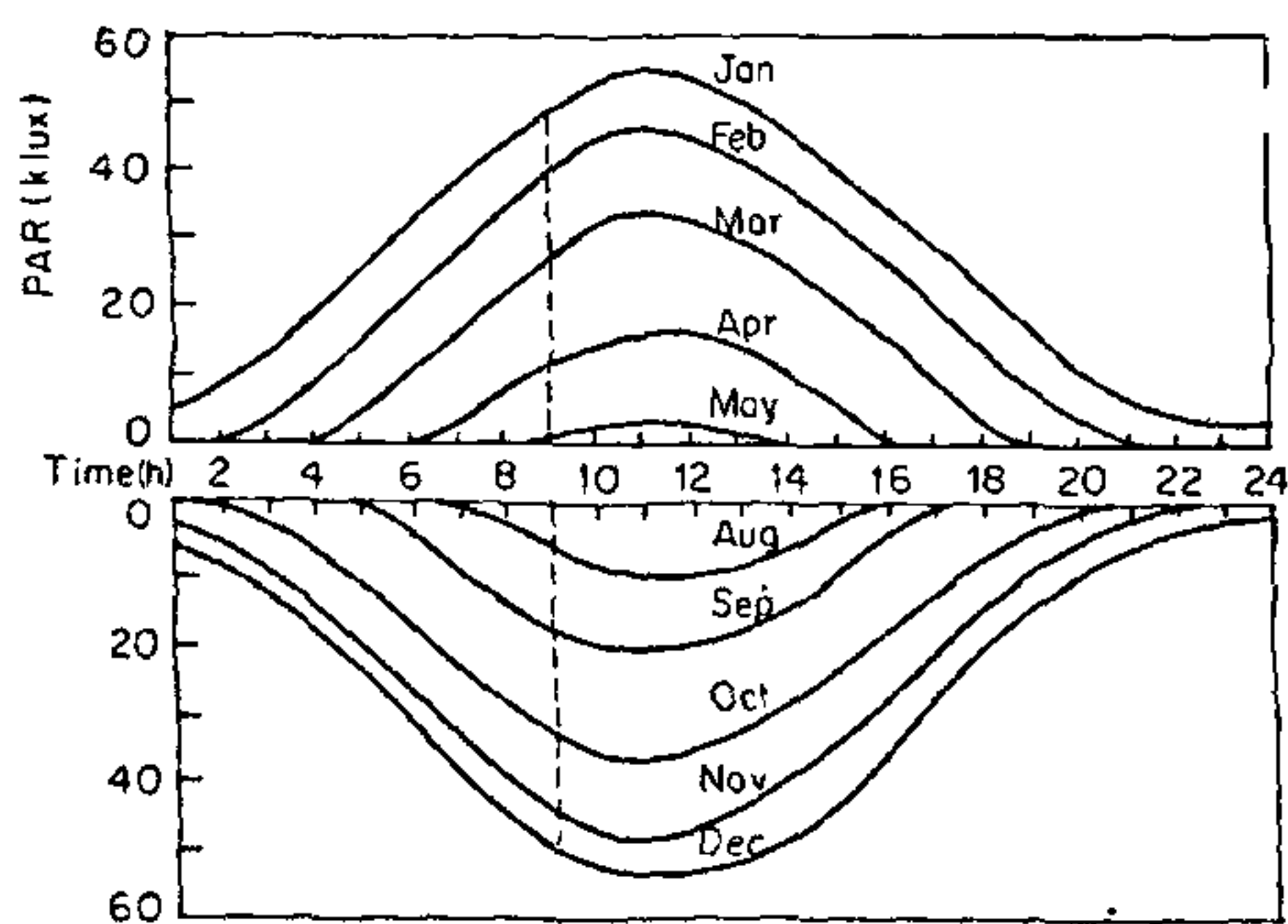


Figure 2. PAR in greenhouse (at Maitri station).

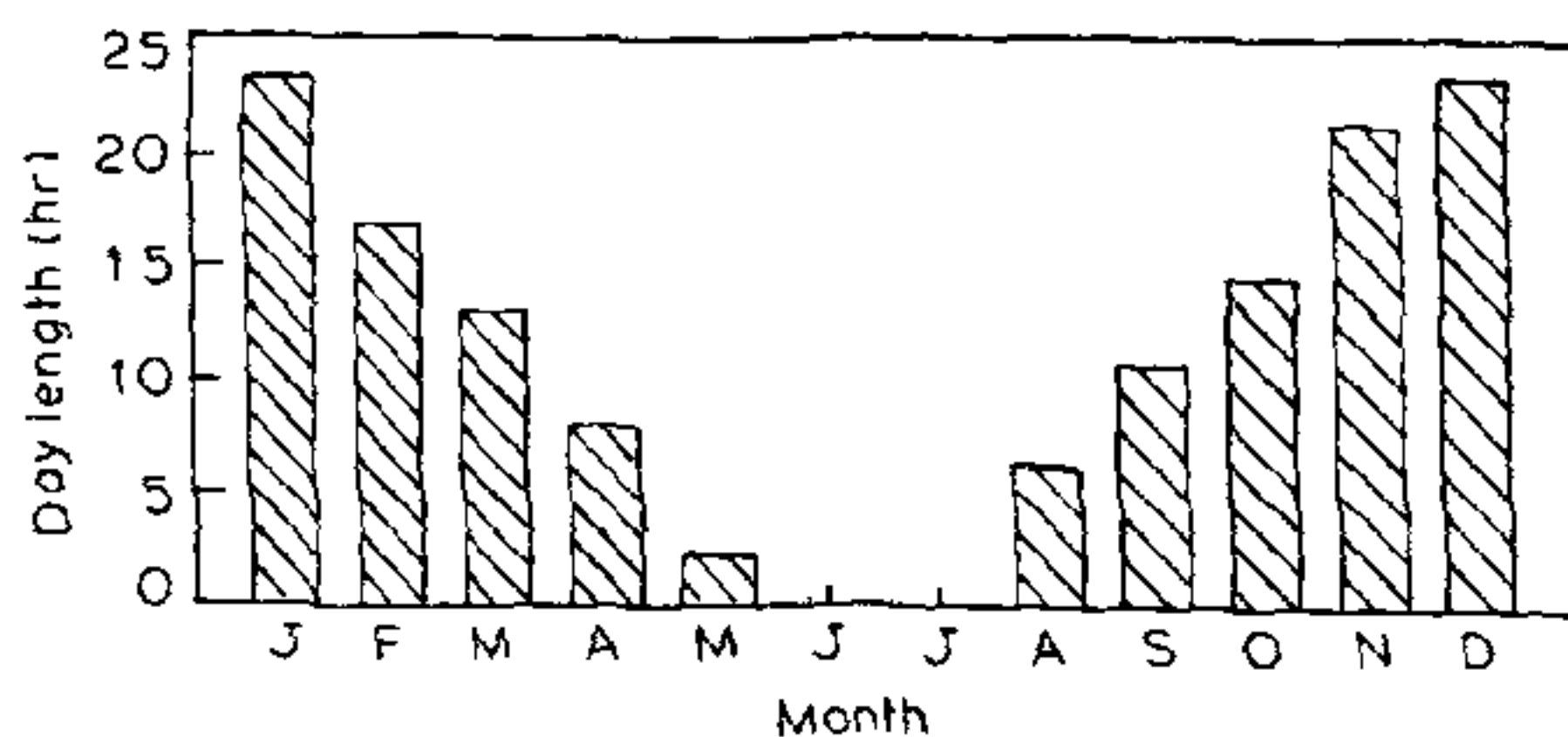


Figure 3. Daylength in Antarctica (at Maitri station).

The conditions under which PAR should be measured are also discussed. McCree⁹ has also described the measurement of PAR. Graham and Phenix¹⁰ have described the measurement of natural irradiance in greenhouses.

The extraterrestrial strength of illumination amounts to an average of 140,000 lux. Siedentopf and Reger¹¹ have measured global illumination at noon time in various northern latitudes under cloudless sky. Noon-time illumination at 70°N latitude was reported as 36 klux and 84 klux in March–September and June, respectively. The corresponding values in Antarctica were 50 klux in March, 35.82 klux in September and 89.28 klux in December. The values are almost symmetric and closer in value, which is also evident from the symmetry of poles. The illumination depends on solar angle and increases with increase in solar angle. In Antarctic, the sun is never overhead and solar angle never rises above 46°. The solar angle varies from 0° to 46° from 1 July to 31 December and then decreases from 46° to 0° from 1 January to 21 June at Maitri station. According to IMD¹², at 70°S 12°E in Antarctica, sunrise occurs at all angles along the horizon on the eastern side and sunset occurs at all azimuth angles on the western side of the celestial dome during the course of one revolution of earth around the sun. Since the station is located to south of 66.5°S, the Antarctic circle, it has a period of continuous sunlight from 22 December to 24 January and no sunshine period from 31 May to 20 July. Due to its high latitude position, the solar elevation at local apparent noon varies between 1058 h and 1125 h (GMT) during the year.

Clouding, naturally, influences both the strength of illumination and global radiation very considerably. This factor is highly significant in Antarctica. Under a cloud-covered sky the illumination averages about 27% of that under a clear sky. In the presence of scattered clouds, it is possible that a reflection effect may produce an increase in the strength of illumination. The high albedo for ice surface also amounts to an increase in net strength of illumination in Antarctica.

The data presented here show PAR availability at 70°S for one complete revolution of earth around the sun. The data may find applications in plant science, oceanography and marine biology in Antarctic region.

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Reversal of interferon-induced lymphokine-activated killer resistance in two murine cell lines by exposure to acid pH

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Interferon is known to augment the expression of MHC I antigens on a variety of tumour cell lines. In most cases, a simultaneous decline in the susceptibility of these tumour cells to natural killer (NK) cells and lymphokine-activated killer (LAK) cells is also observed. In the present communication, we have studied the LAK susceptibility and MHC I levels on two NK-resistant murine cell lines P815 and SP₂O. Treatment with interferon resulted in an increased MHC I expression as well as a decreased LAK susceptibility in both cell lines. A brief exposure of the interferon-treated tumour cells to citrate buffer (pH 3) resulted in a marked decline in the levels of MHC I and restoration of LAK susceptibility of the target cells. A direct role of MHC I antigens in determining the LAK

susceptibility of target cells is suggested by these results.

LYMPHOKINE-activated killer (LAK) cells are derived primarily from natural killer (NK) cells by interleukin-2 (IL-2) activation. There are qualitative differences between LAK cells and NK cells as the former are more efficient killers and lyse a wider range of target cells, including NK-resistant target cells. Quantitative expression of MHC I antigens on a tumour cell may be an important factor in determining its susceptibility to NK cells. In many systems, an inverse correlation between the quantitative MHC antigen expression on target cells and susceptibility to NK lysis has been demonstrated (reviewed by Ljunggren and Karre¹). Some recent studies have sought to investigate the role of target cell MHC class I antigen expression on LAK susceptibility of target cells. Wiebke *et al.*² have reported that a clear-cut correlation between enhanced MHC antigen expression and decreased LAK susceptibility was not observed in human tumour cell lines. Similar results were also reported by De Fries and Golub³, who observed that LAK susceptibility of certain human tumour cell lines following interferon treatment is not dependent on increased class I antigen expression. However, by depleting class I antigen expression by exposure to acid pH, Miyatake *et al.*⁴ reported that interferon-induced resistance to LAK lysis in cultured human gliosarcoma cells is, at least in part, due to enhanced levels of class I antigen expression.

In the present report, we have investigated the LAK susceptibility of two NK-resistant cell lines of murine origin, in which MHC I expression was initially boosted by interferon treatment and reduced thereafter by acid pH treatment: P815 (mastocytoma) and SP₂O (myeloma) cell lines used in this study were propagated in culture in RPMI-1640 supplemented with 10% FCS, 2×10^{-5} 2-mercaptoethanol, 300 µg/ml glutamine and 60 µg/ml gentamicin (complete medium). In order to generate LAK cells, spleen cells from C57B1/6 mice were cultured at 5×10^6 cells/ml with 200 U/ml of interleukin 2 (IL-2, a kind gift from Hoffmann La Roche, Nutley, NJ) in complete medium. After two days, cultures were split into two and supplemented with equal volumes of fresh medium and 200 U/ml IL-2. Cells harvested on day 5 from initiation of culture were washed and used as LAK effector cells.

Tumour cells were cultured (5×10^4 cells/ml in complete medium) with or without 200 U/ml recombinant murine interferon gamma for 48 h. After culture, the cells were harvested and washed. Portions of these IFN-treated tumour cells were subjected to a brief pH 3 treatment as described by Sugawara *et al.*⁵. Briefly, cell pellets were suspended in 0.5 ml of cold 0.2 M citric-acid-Na₂PO₄ buffer (pH 3.0), containing 1 g/100 ml of bovine serum albumin. After 2 min,