SOLAR RADIATION MEASUREMENT PROJECT

XAVIER UNIVERSITY
NEW ORLEANS, LA

NASA RESEARCH GRANT NO. 8050

FINAL REPORT

31 December 1981

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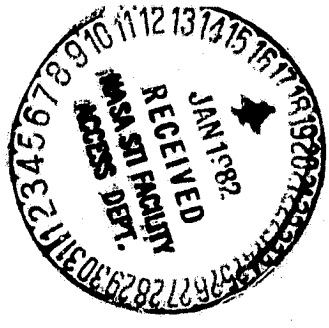

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SOLAR RADIATION MEASUREMENT PROJECT

Introduction

The Xavier Solar Radiation Measurement Station is part of a project to provide data on solar insolation in the New Orleans area. Permanent equipment is located at the Xavier University campus, with additional portable equipment for use at selected sites in the surrounding area. This final report briefly describes the accomplishments completed during the period of funding by NASA, from 2 June 1977 to 31 December 1981.

Overall Summary

"The Physics Teacher" is the journal of the Louisiana Section of the American Association of Physics Teachers. Its editor invited the principal investigator to write an article about the Xavier Solar Measurement Project for the issue to be published in the spring of 1982. A copy of the article submitted is attached. It gives a brief description of the Xavier Solar Measurement Station and its objectives.

Solar Data

Measurements of the total solar radiation on a horizontal

surface from an Eppley Pyranometer were collected into large computer data files. Total radiation in watt-hours/m^2 was converted from ten-minute intervals to hourly intervals. Graphs of this total solar radiation data on a horizontal surface in New Orleans are attached. Missing data are shown as zeros on the graphs. Plots of the total for each day plotted for an entire month, and the total for each hour for one representative day of each month are shown. Similar plots of the hourly data for any other day may be easily obtained from the computer.

A computer program in FORTRAN was written to calculate the total extraterrestrial radiation on a horizontal surface for each day of the month. This provides a useful comparison with the total solar radiation collected at the surface of the earth. Plots of these calculated values for each month of the year are attached.

Talks at Scientific Meetings

The following list summarizes the papers presented at scientific meetings and elsewhere by members of the Xavier Solar Radiation Measurement Project. Except where noted, the presentation was by the principal investigator.

4 Feb 1978 - "Solar Insolation Measurements from Xavier" - Louisiana Academy of Sciences, Nicholls State University, Peter Jupiter, student research assistant

29 May 1979 - "Insolation Measurements for Solar Energy Research"- American University in Cairo Cairo, Egypt

5 Dec 1979 - "Solar Energy" - New Orleans Chapter of the National Council of Jewish Women

8 Feb 1980 - "The Xavier Solar Measurement Station" - Louisiana Academy of Sciences, Southeastern Louisiana University, Jarvis Jacobs, student research assistant

25 Feb 1980 - "Application of Solar Energy in Oil Mill Processing" - 29th Annual Oil Seed Processing Clinic, New Orleans

18 Mar 1980 - "Solar Energy" - Edison League, New Orleans

14 July 1980 - "Solar Energy" - Sierra Club, Mandeville, LA

18 Oct 1980 - "Some Simple Solar Experiments" - Louisiana Section of the American Association of Physics Teachers, New Orleans

6 Feb 1981 - "Solar Radiation Data for New Orleans" - Louisiana Academy of Sciences, LSU at Alexandria, Don Boucree, student research assistant

6 Feb 1981 - "A Solar Powered pH Meter" - Louisiana Academy of Sciences, LSU at Alexandria, Thomas Bullock, student research assistant

27 Feb 1981 - "Solar Radiation Data for New Orleans" - Zone 5 meeting of the Society of Physics Students, University of New Orleans, Don Boucree, student research assistant

27 Feb 1981 - "A Solar Powered pH Meter" - Zone 5 meeting of the Society of Physics Students, University of New Orleans, Thomas Bullock, student research assistant

27 Feb 1981 - "Passive Solar Energy" - Zone 5 meeting of the Society of Physics Students, University of New Orleans, Rene Farve, student research assistant

Publicity

Publicity for solar energy in the New Orleans area as a result of the Xavier Solar Radiation Measurement Project has ranged from articles in the weekly newsletter of Xavier University to articles in the New Orleans daily newspaper, television coverage, etc. Such events include the following:

16 Feb 1978 - newspaper article in weekly paper "Figaro"

26 June 1978 - television program on Public TV Station WYES-TV

fall 1978 - solar installations list of Louisiana Ecology Center

27 Jan 1981 - article in weekly Xavier University Newsletter "This Week at Xavier" (most recent of many articles)

5 Apr 1981 - newspaper article in daily paper "Times-Picayune/States-Item"

Project Accomplishments

Several goals have been reached by the Xavier Solar Radiation Measurement Project during the period of funding by NASA. These include the following:

1. Introduction of undergraduate students majoring in physics or pre-engineering to the ideas, techniques, and procedures of physics research. This includes working with state-of-the-art equipment, computers, analyzing data, writing reports, and presenting research talks at scientific meetings. This opportunity would not otherwise be available to them in a small department in a small univer

In addition to the primary involvement in the solar radiation measuring activities during the past few years, students have participated in a variety of spin-off projects stimulated by the solar measurements. Some representative examples are: an engineering design contest between two student teams for a flat-plate solar collector, many student presentations at the weekly Xavier Physics/Pre-Engineering Seminar, and the design and construction

of a solar-powered pH meter (funded by E. I. Du Pont De Nemours and Company).

2. Increase of the amount of information available on solar insolation in New Orleans, resulting from the data collected and analyzed by the sophisticated solar radiation measuring equipment. A comprehensive solar radiation measuring station did not exist in New Orleans prior to the Xavier Solar Measurement Station.

3. Enrichment of the background of the principal investigator, technical assistant, and student research assistants by providing funds for attendance at solar energy related short courses, scientific meetings, conferences, etc.

4. Enlargement of the Xavier Physics/Pre-Engineering holdings in the area of solar energy from the purchase of current text and reference books and other audio-visual materials such as filmstrips, cassettes, etc.

5. Favorable publicity for solar energy in the New Orleans area, especially in the Black community.

It is planned to continue the activities of the Xavier Solar Measurement Project. In many instances long term averages and trends in solar data are needed for meaningful interpretation. The early part of the grant period was used to obtain and install equipment. Recent efforts as well as those of the future primarily involve continued use of and automation of the collecting equipment with subsequent refinement of data analysis techniques.

submitted to "The Physics Teacher" on 4 Dec 1981

SOLAR RADIATION MEASUREMENT PROJECT

Physics/Pre-Engineering Department
Xavier University
Juliette W. Ioup, Principal Investigator

The solar radiation measurement project of the Physics/ Pre-Engineering Department of Xavier University in New Orleans is designed to obtain information about the incident solar radiation in the area. These data coupled with measurements of relevant climatic and environmental conditions will provide valuable information useful for the design and construction of solar energy systems such as those needed for space heating and cooling of buildings, hot water heating, electric power generation, etc. Since there have been no other solar insolation measurement stations in New Orleans or the surrounding region, data collected are extremely valuable to architects, engineers, and designers of solar energy systems in this area. The Xavier project began in June 1977 and is supported by NASA through the Marshall Space Flight Center, Huntsville, AL.

The amount of energy production by the use of solar energy depends not only on the amount of energy reaching the upper atmosphere of the earth from the sun, but also on the atmospheric conditions at the site. The cloud cover, particulates in the atmosphere, atmospheric transmissivity, etc., all influence

the amount of energy actually reaching the surface of the earth. Insolation data collected will be used in an attempt to evaluate the effects of these factors.

The principal measurement site is the roof of the Xavier Administration Building, at the Xavier Solar Measurement Station. Data collection is also possible at other locations using portable instruments. Current equipment includes the following: two pyrheliometers with solar trackers for the measurement of the direct solar component; three pyranometers, one for total flux measurement, one for use with a shadow band to obtain the diffuse radiation, and one to measure radiation received at an angle with respect to the horizontal; an electronic integrator and printer to sum and record insolation over selected time intervals, used primarily with a pyranometer; a portable mechanical meteorograph to record temperature, humidity, and barometric pressure; an instrument shelter; an anemometer and wind vane for wind speed and direction; a wind rose integrator for wind speed and direction averages; one ultraviolet and two infrared radiometers to provide data outside the visible region, with a shadow band for one infrared radiometer; two portable solar power meters for data collection off-campus; electronic probes to detect temperature, barometric pressure, humidity, and a tipping bucket collector for rainfall; a cascade impactor, air sampler and flow controller for atmospheric particulate detection; and a silicon

photovoltaic cell pyranometer, pyrheliometer, and solar radiometer transmittance meter, for testing and comparison with standard instruments. The data collection and analysis system consists of an IMSAI 8080/22-11 microcomputer with 32 K memory, two floppy disk drives, a CRT terminal, and an Okidata printer. Currently this computer system supports the BASIC and FORTRAN computer languages.

Published solar radiation data for New Orleans consist of estimates of the incident radiation. Comparisons of the actual values obtained at the Xavier Solar Measurement Station with these estimations will be the initial stage of long term comparisons, with appropriate averages obtained over several years in the future. Calculations performed using selected procedures from the literature for prediction of the solar radiation at a particular location to compare with the data from the Xavier equipment may reveal unique effects and problems of the New Orleans area.

Undergraduate research students of the Physics/Pre-Engineering Department have become very involved with solar energy research. In addition to some of the installation and maintenance of the solar equipment, students have begun to analyze the data accumulated, including the development of necessary computer codes. Presentations at the weekly departmental seminar are often on some aspect of solar energy, and research papers by the students

have been presented at the annual Louisiana Academy of Sciences meeting for the past several years.

Students in the solar energy research group have also designed and constructed a solar powered pH meter for the Pontchartrain Works of the Du Pont Company. Batteries for a portable pH meter are charged by a small solar cell panel built into the case for the meter.

The Xavier Solar Radiation Measurement Project is an effective way to involve undergraduate students with physics and physics research using solar energy activities of interest to them and of benefit to the entire community.

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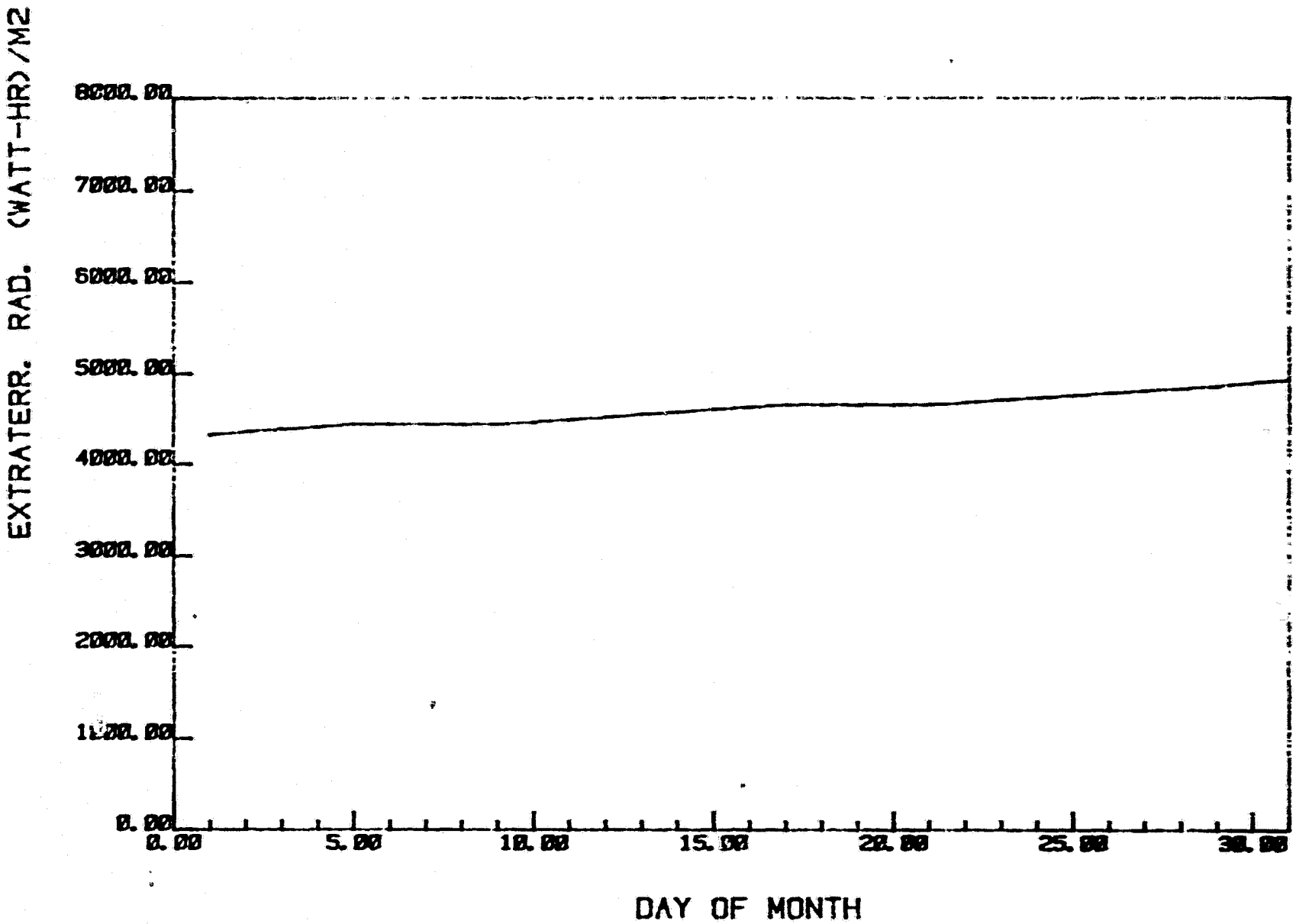

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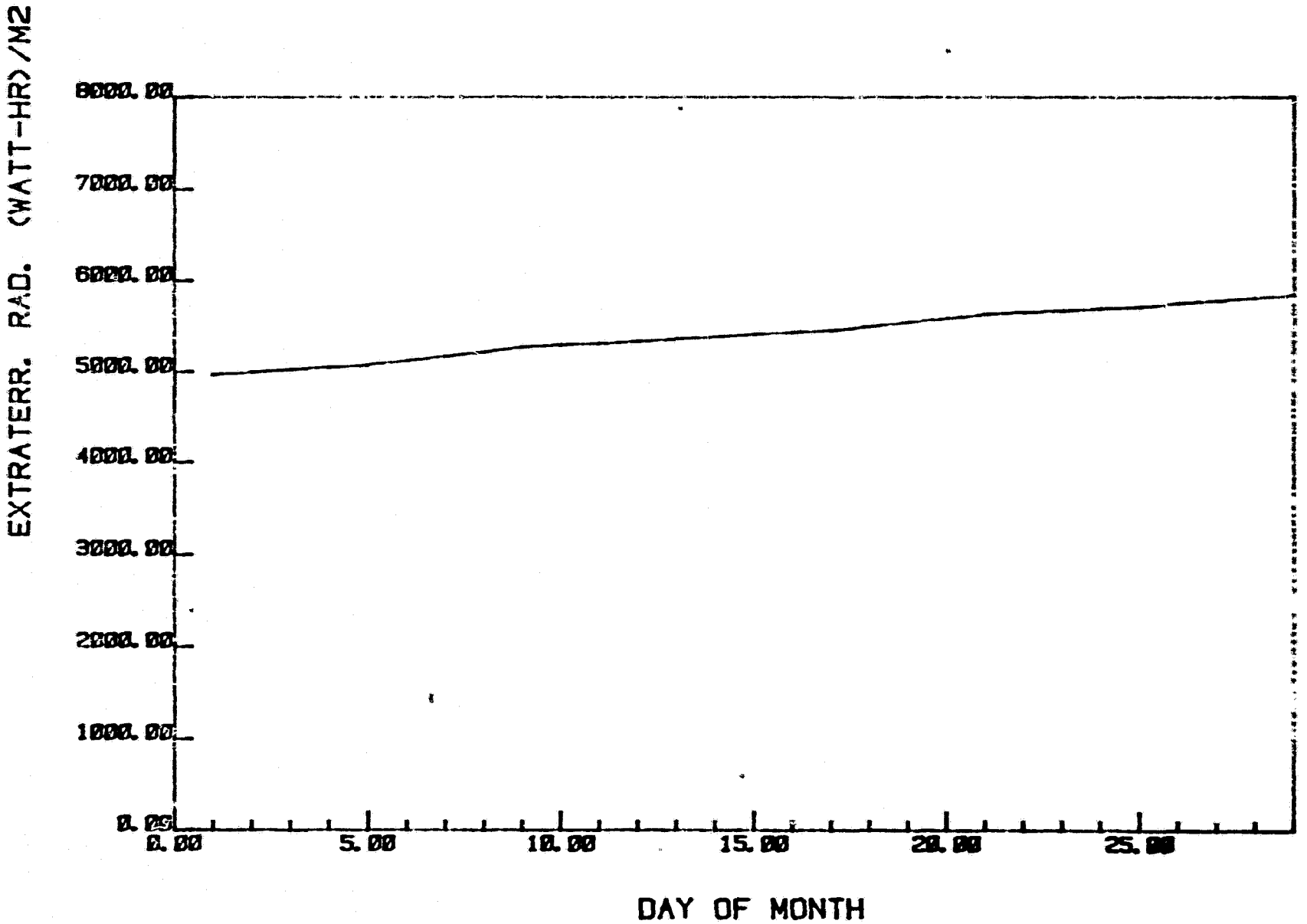

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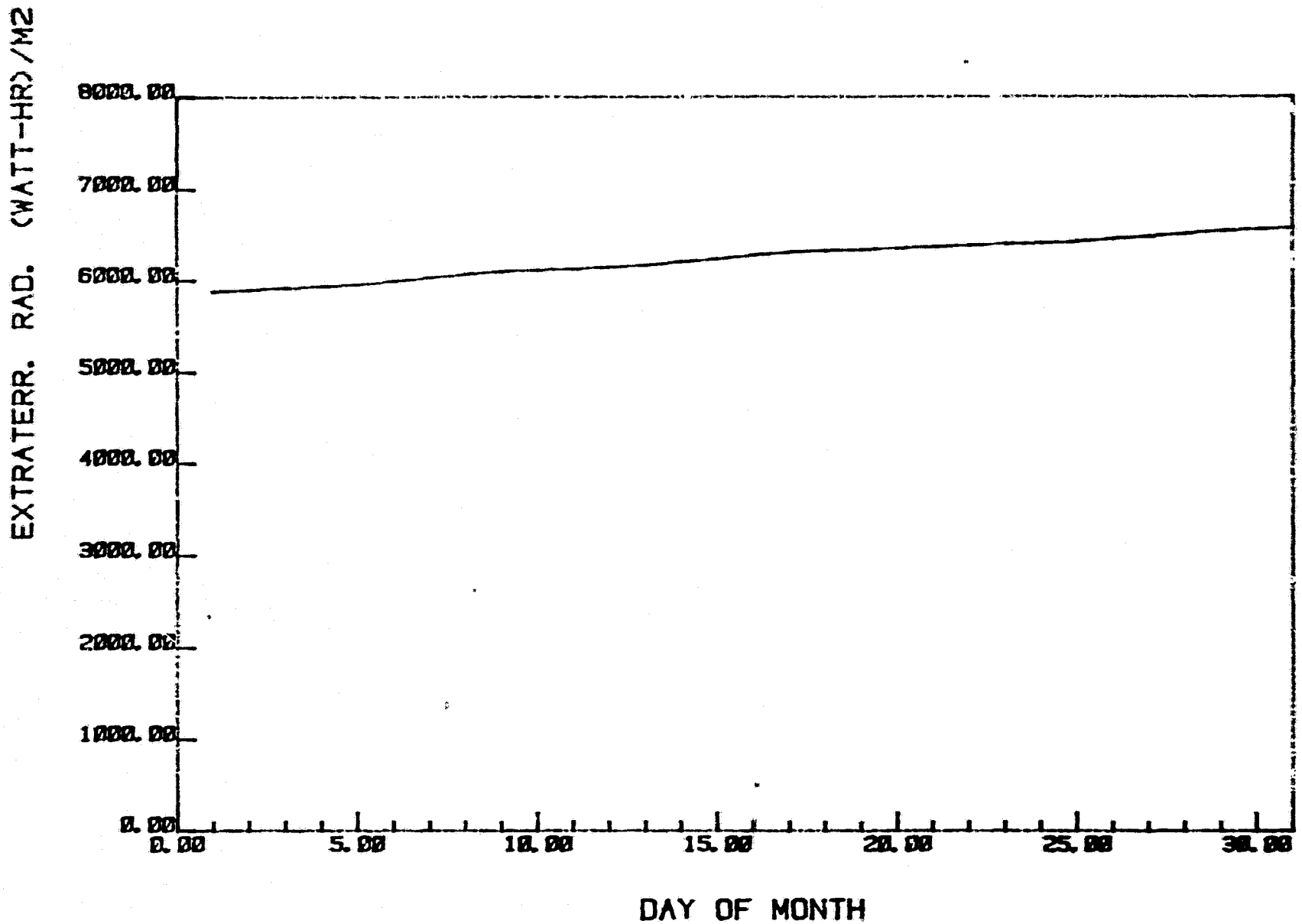

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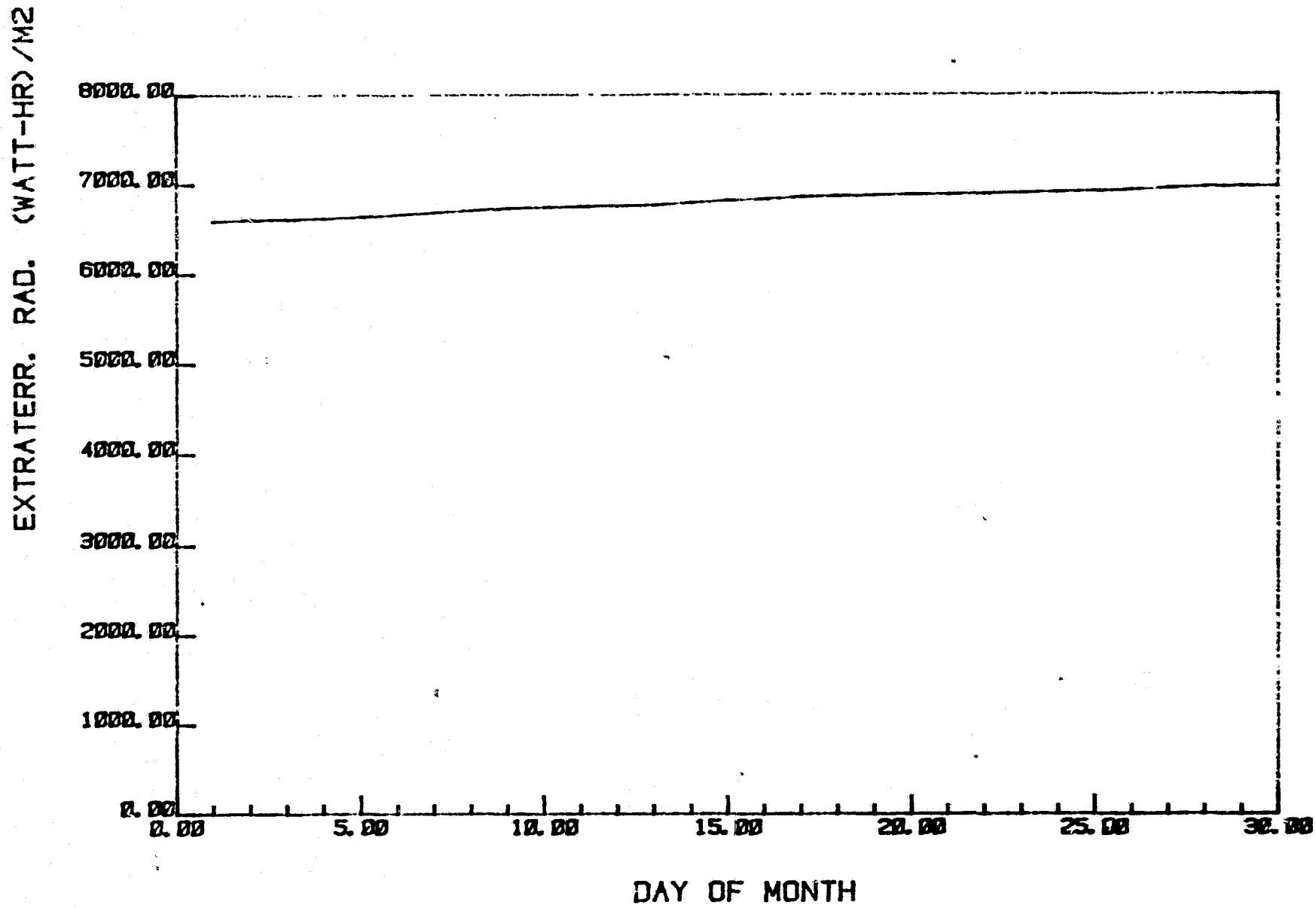

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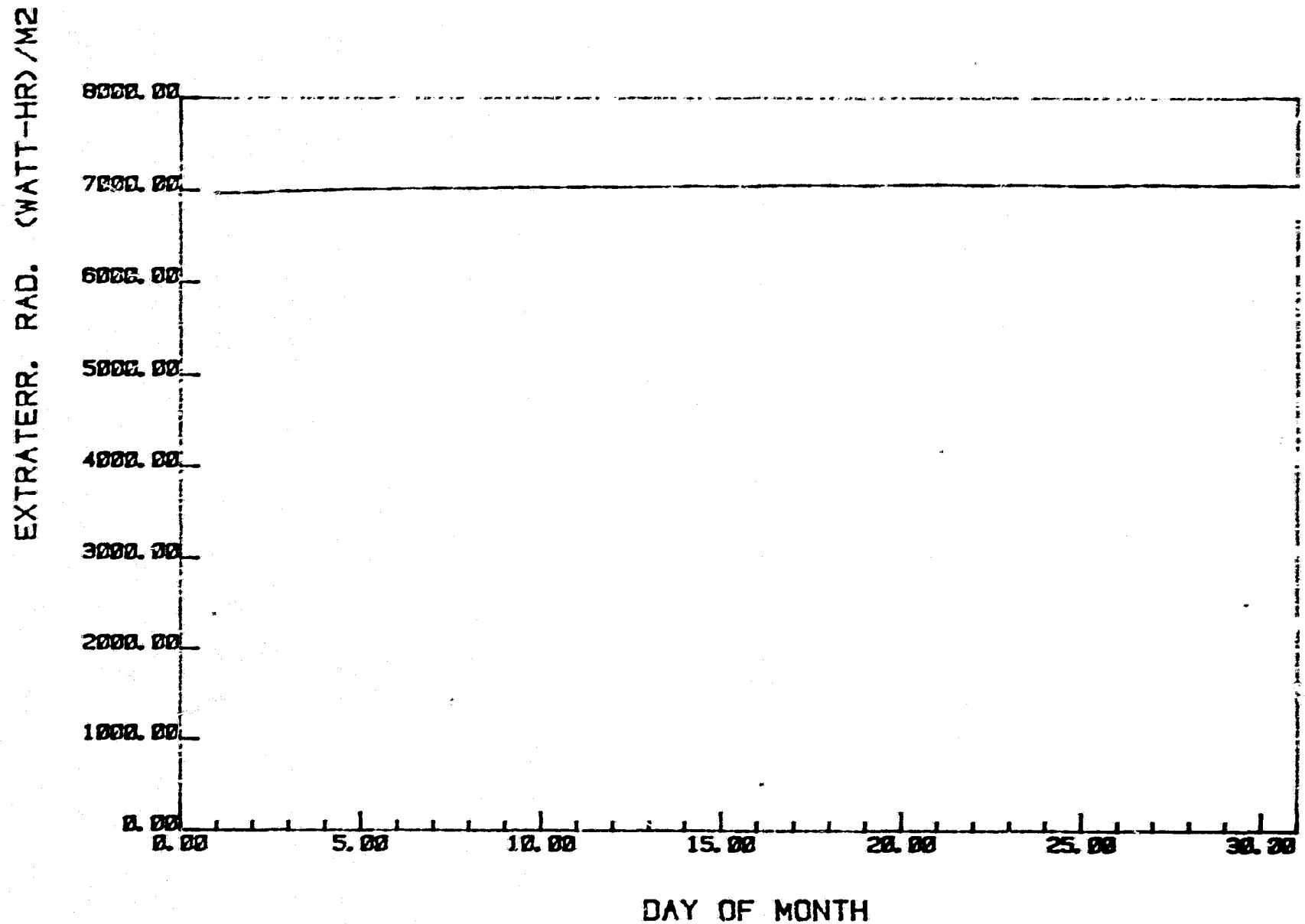

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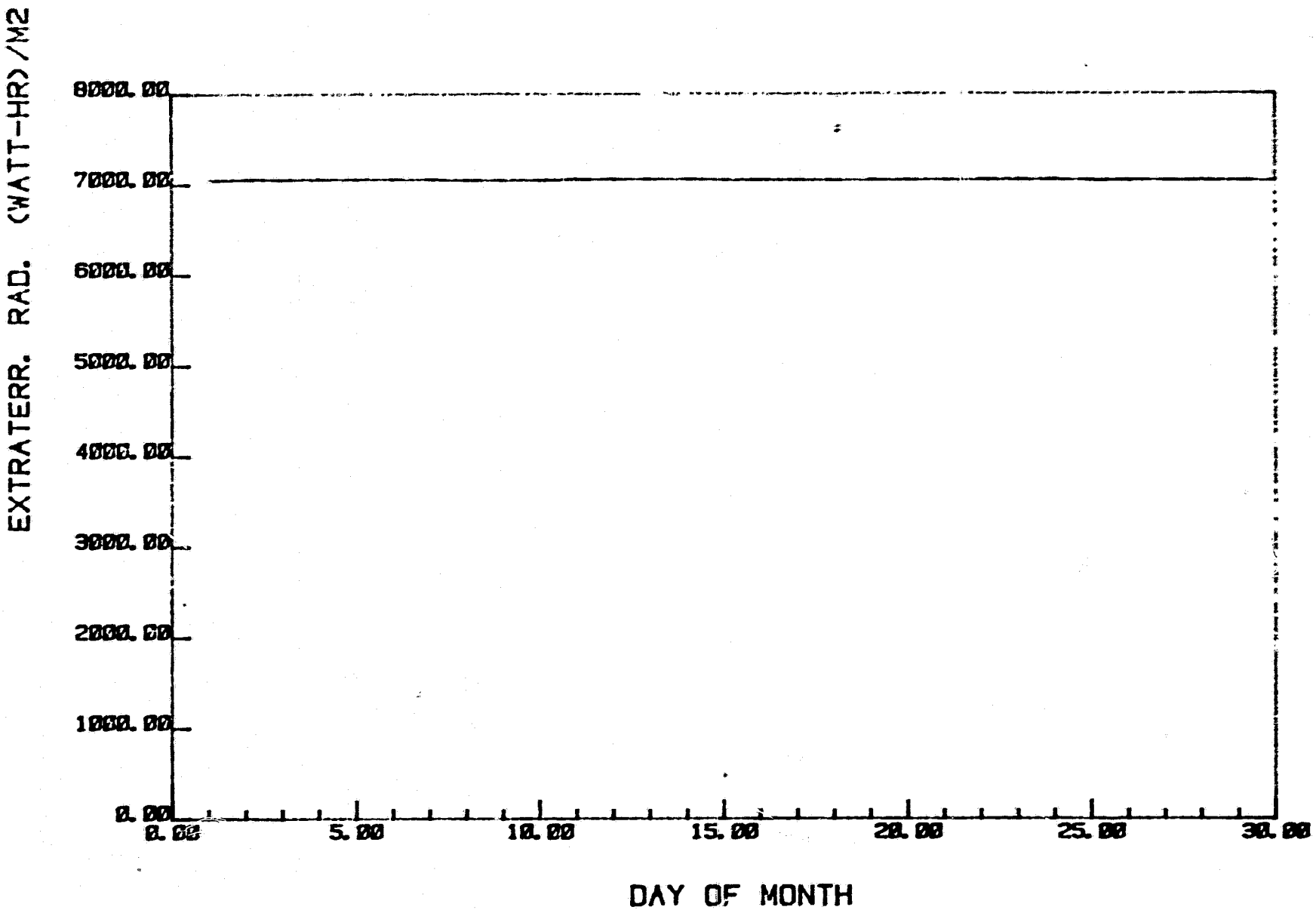

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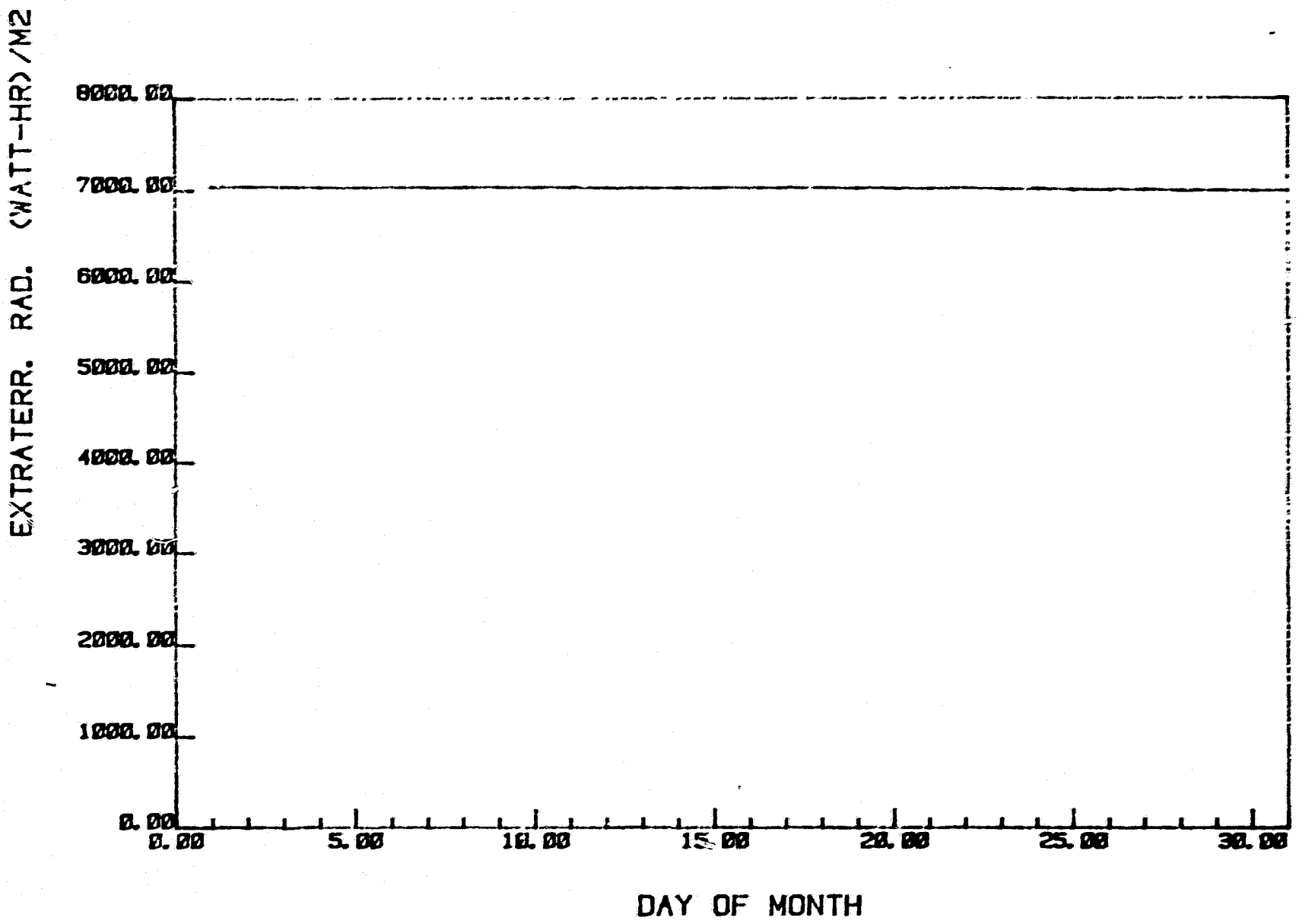

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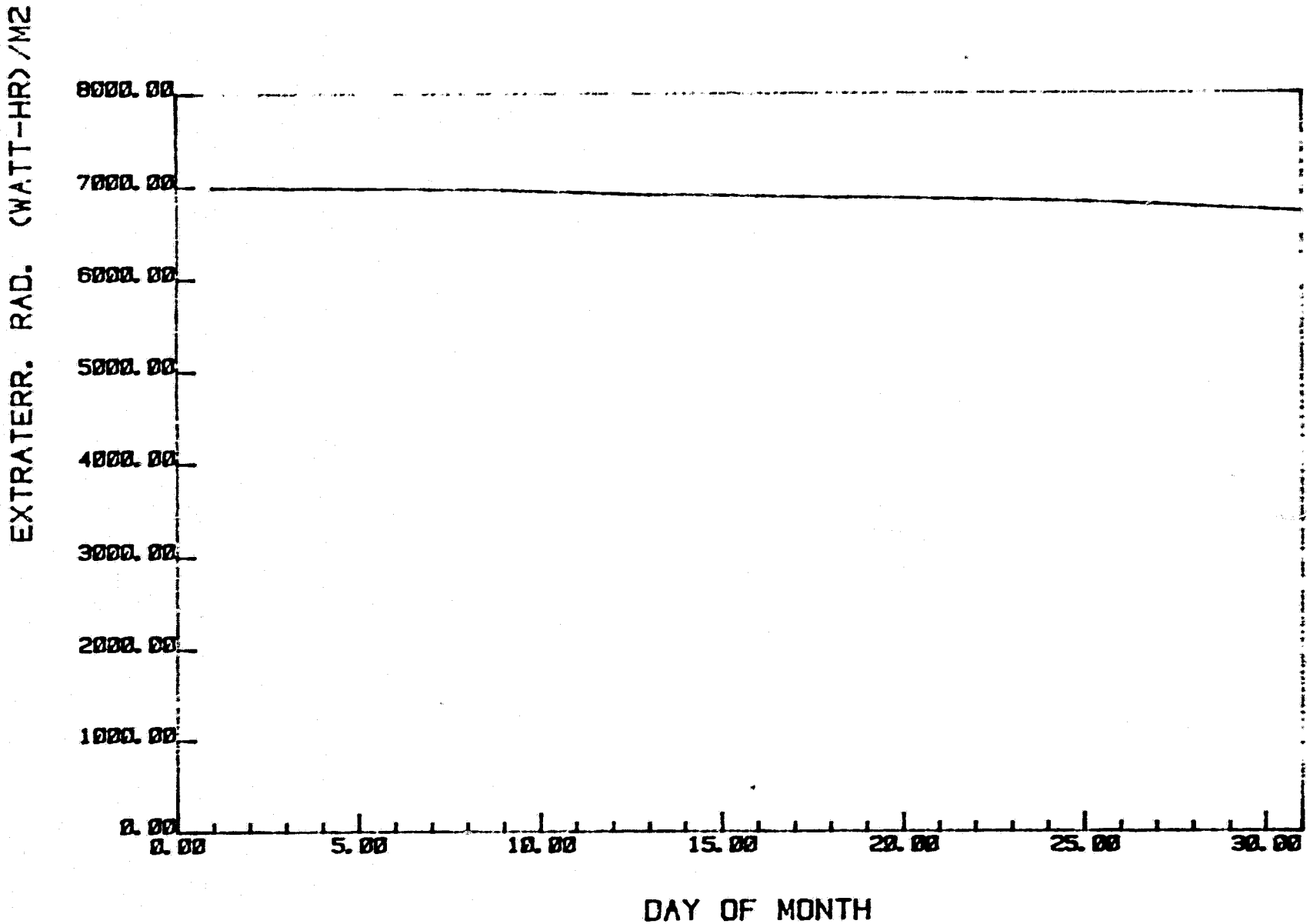

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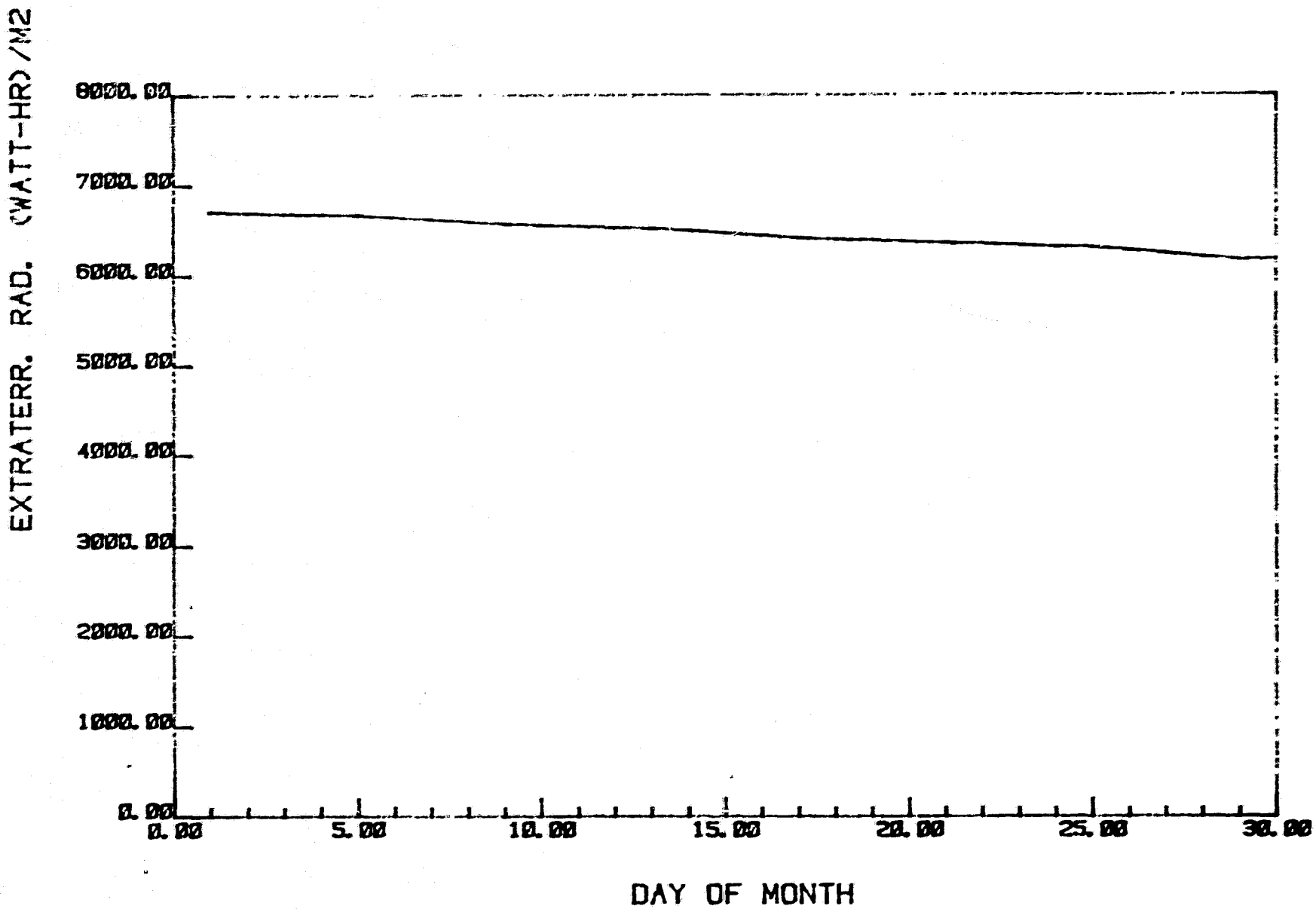

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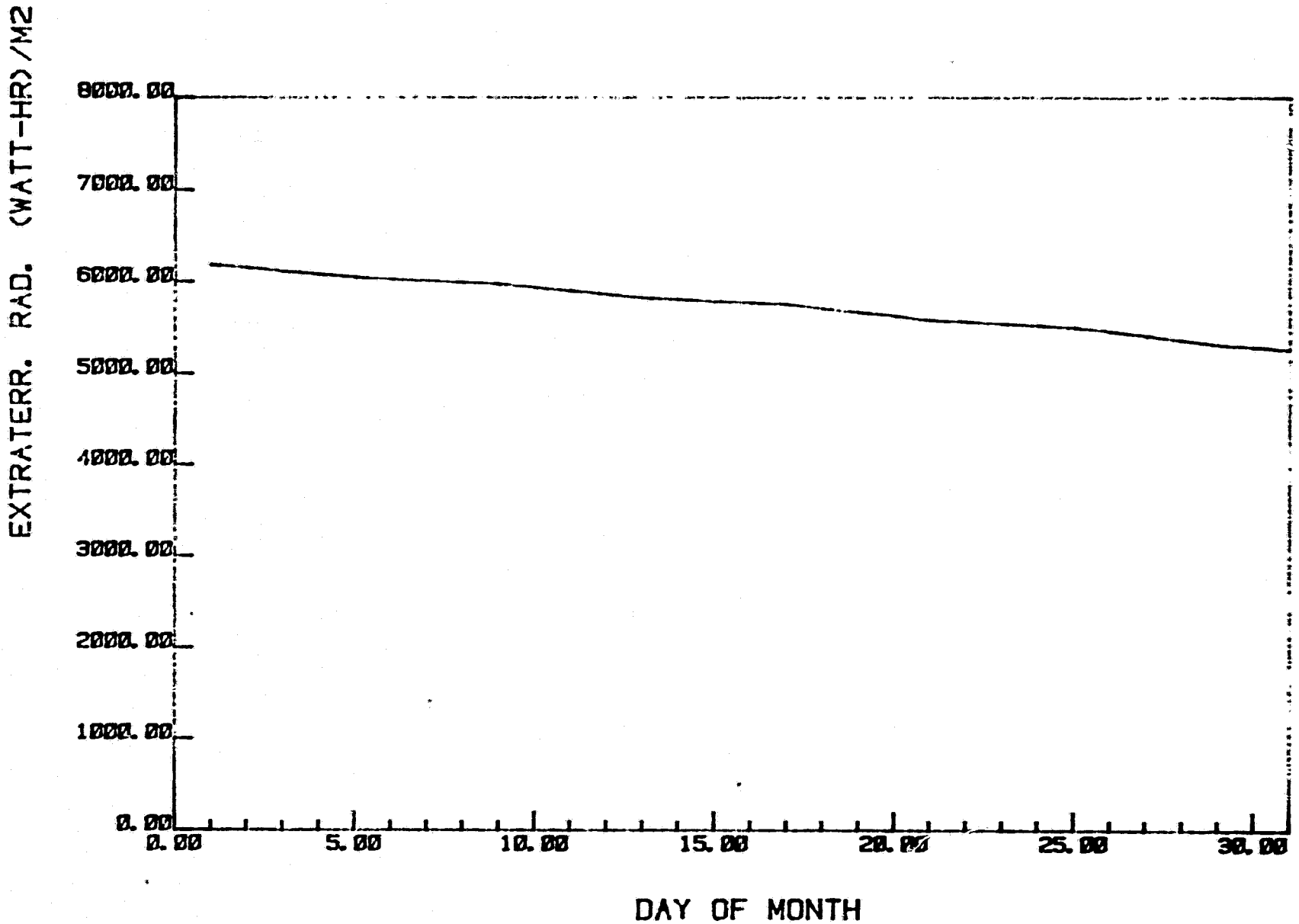

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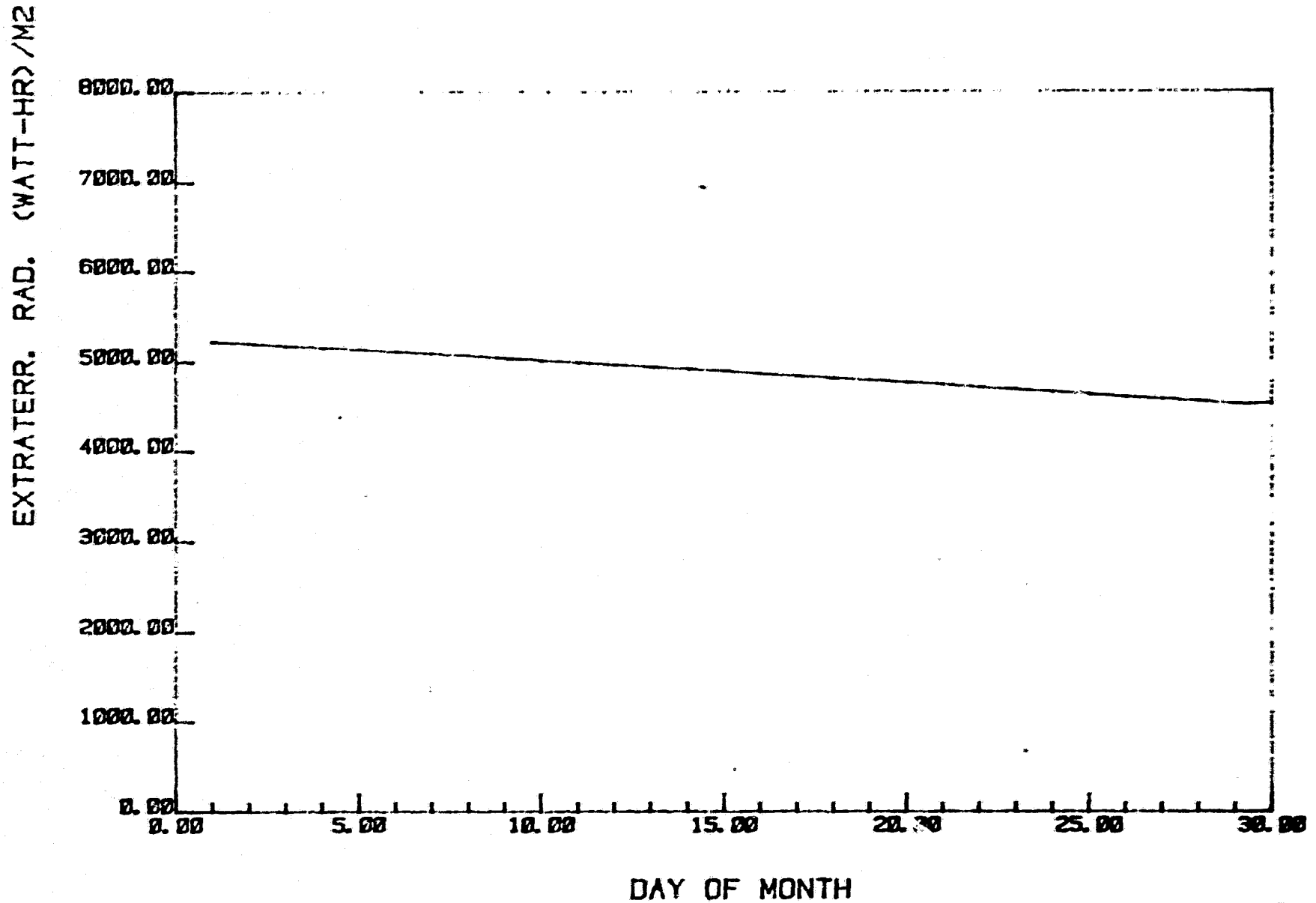

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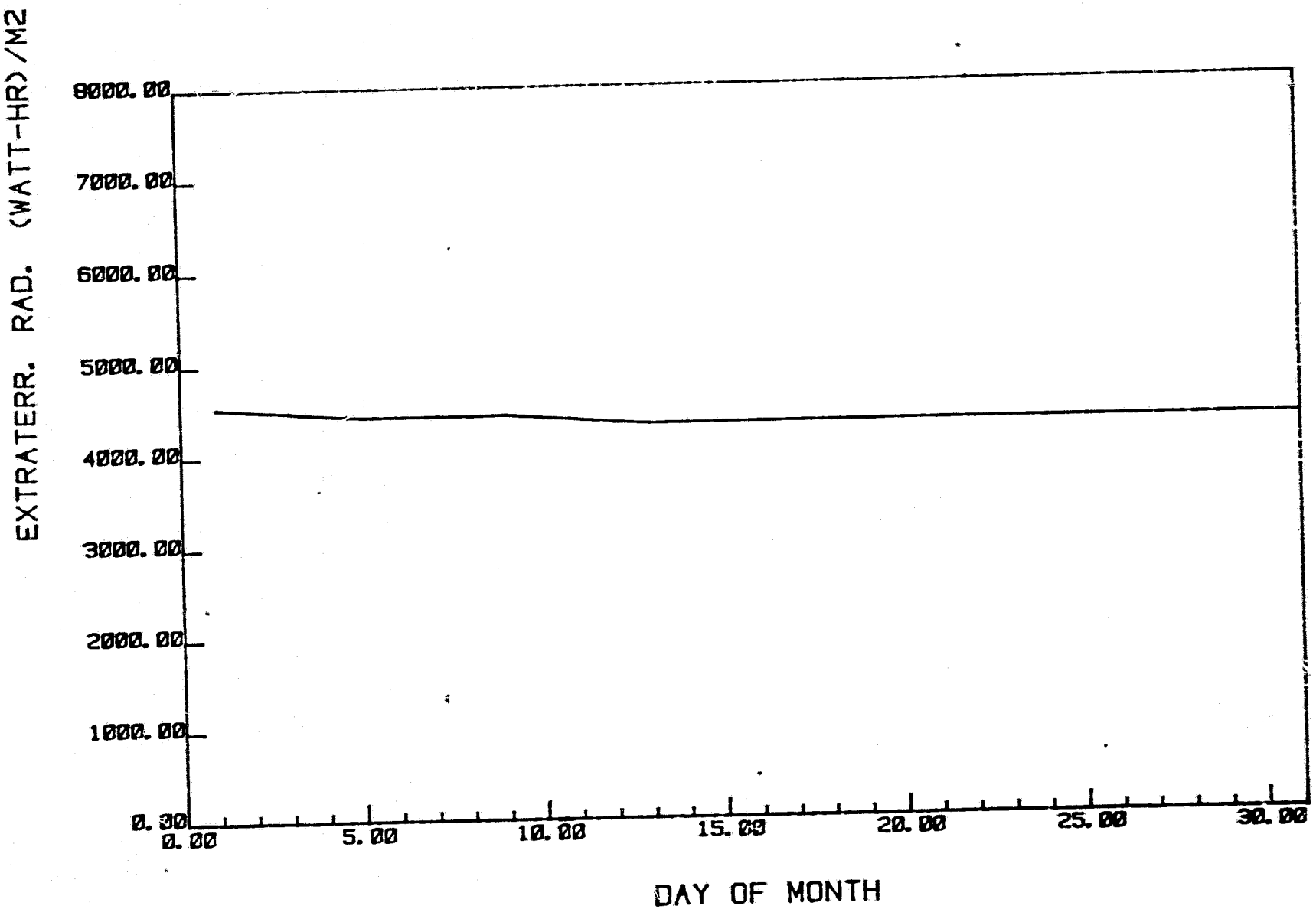

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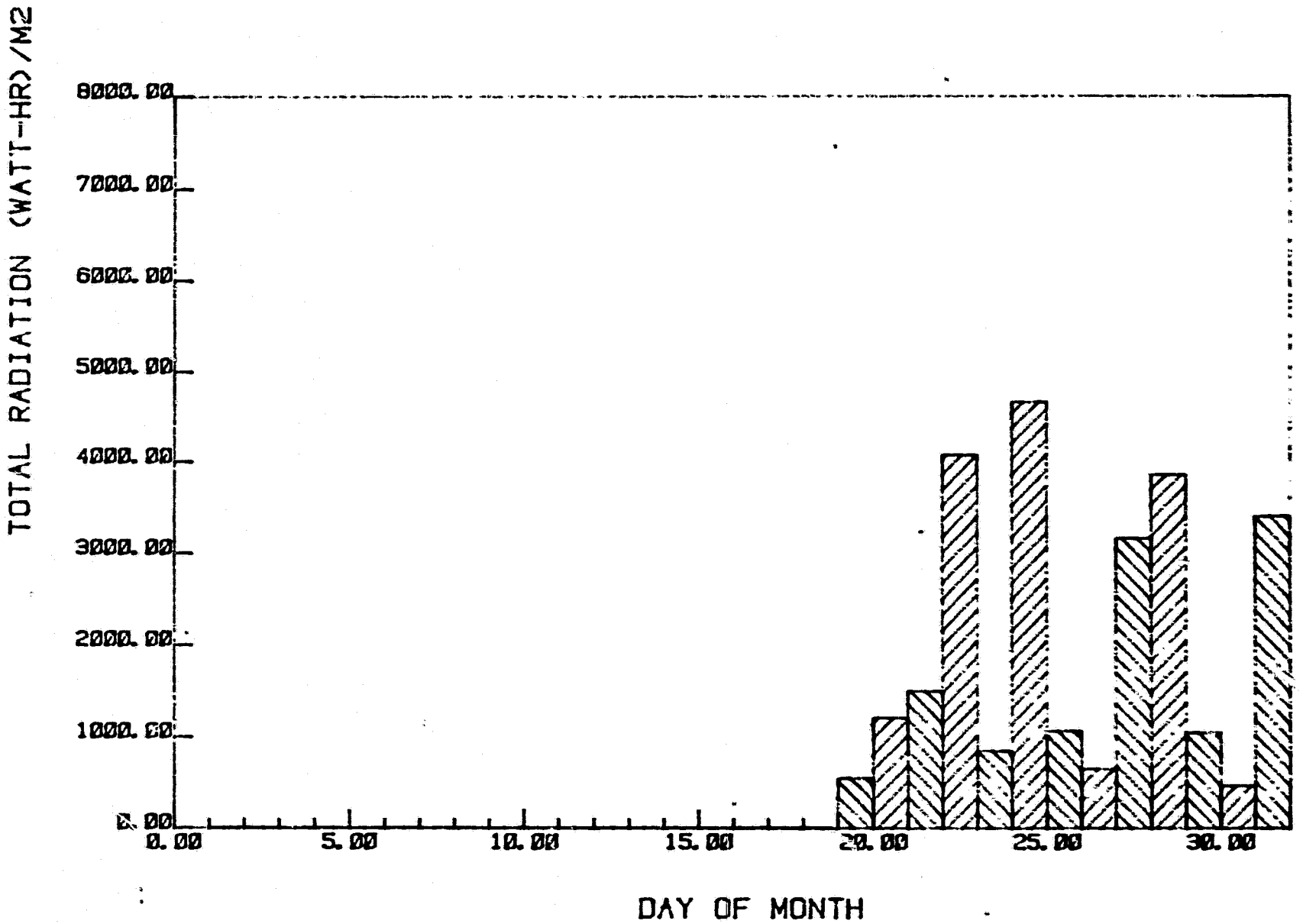

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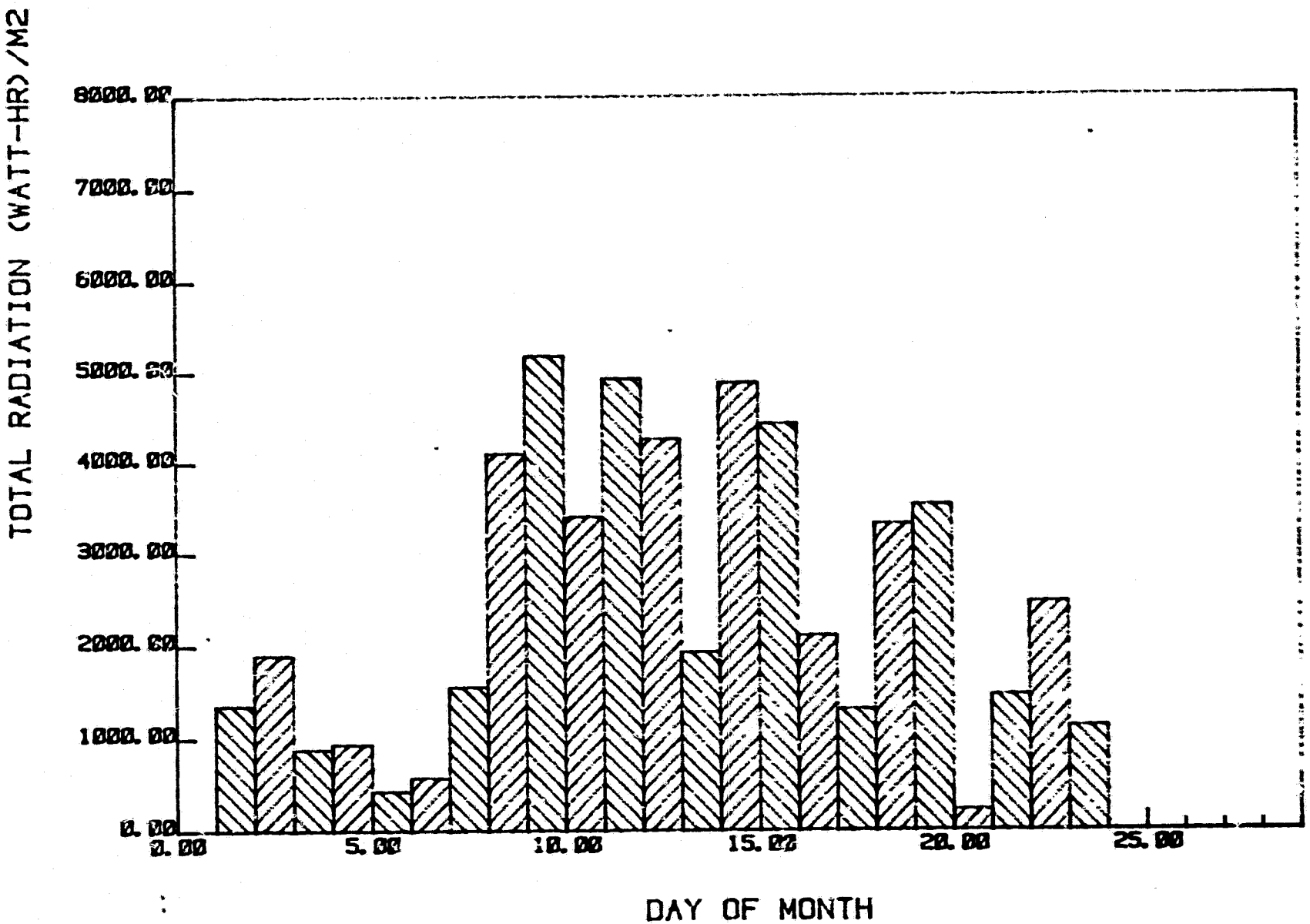

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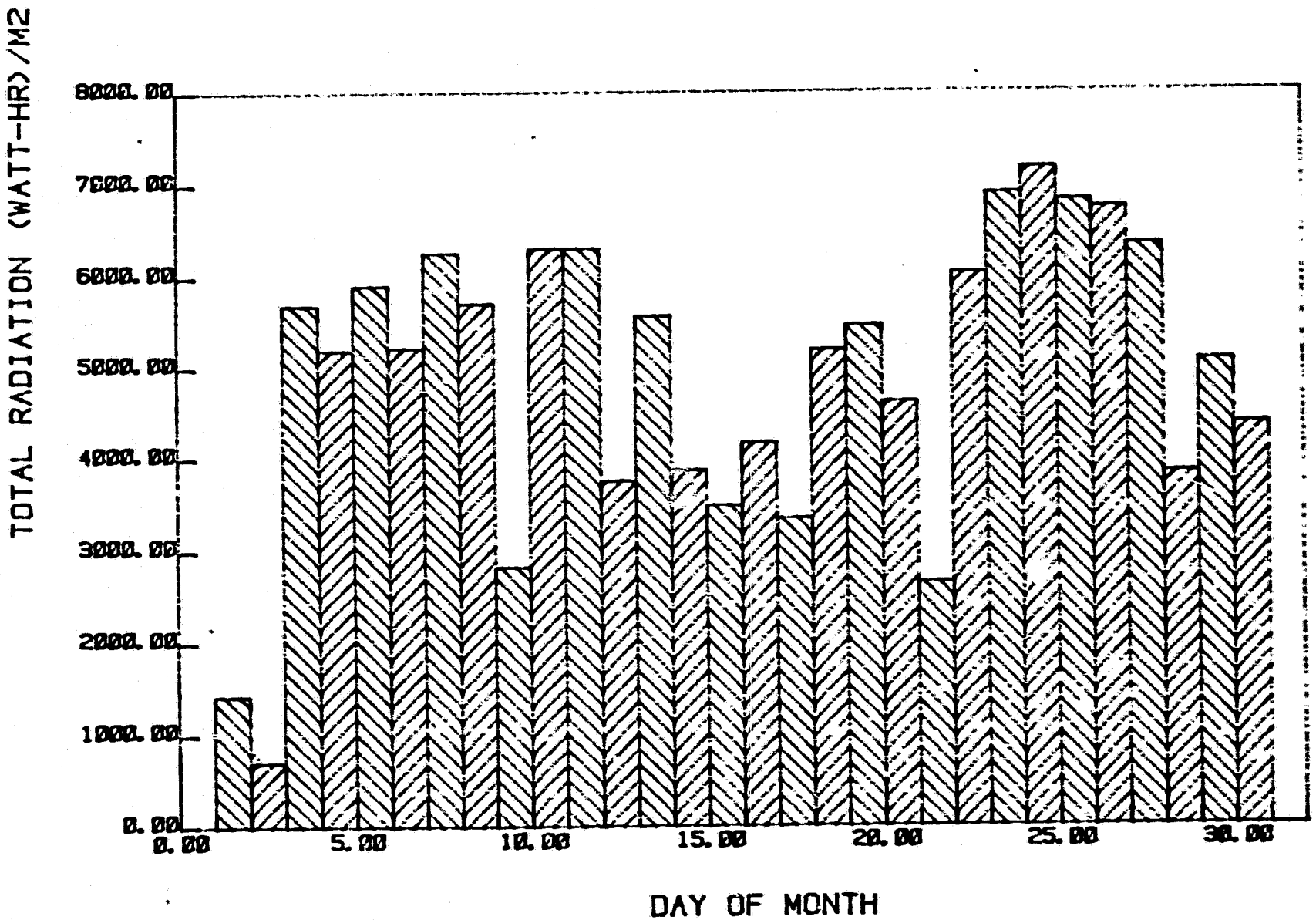

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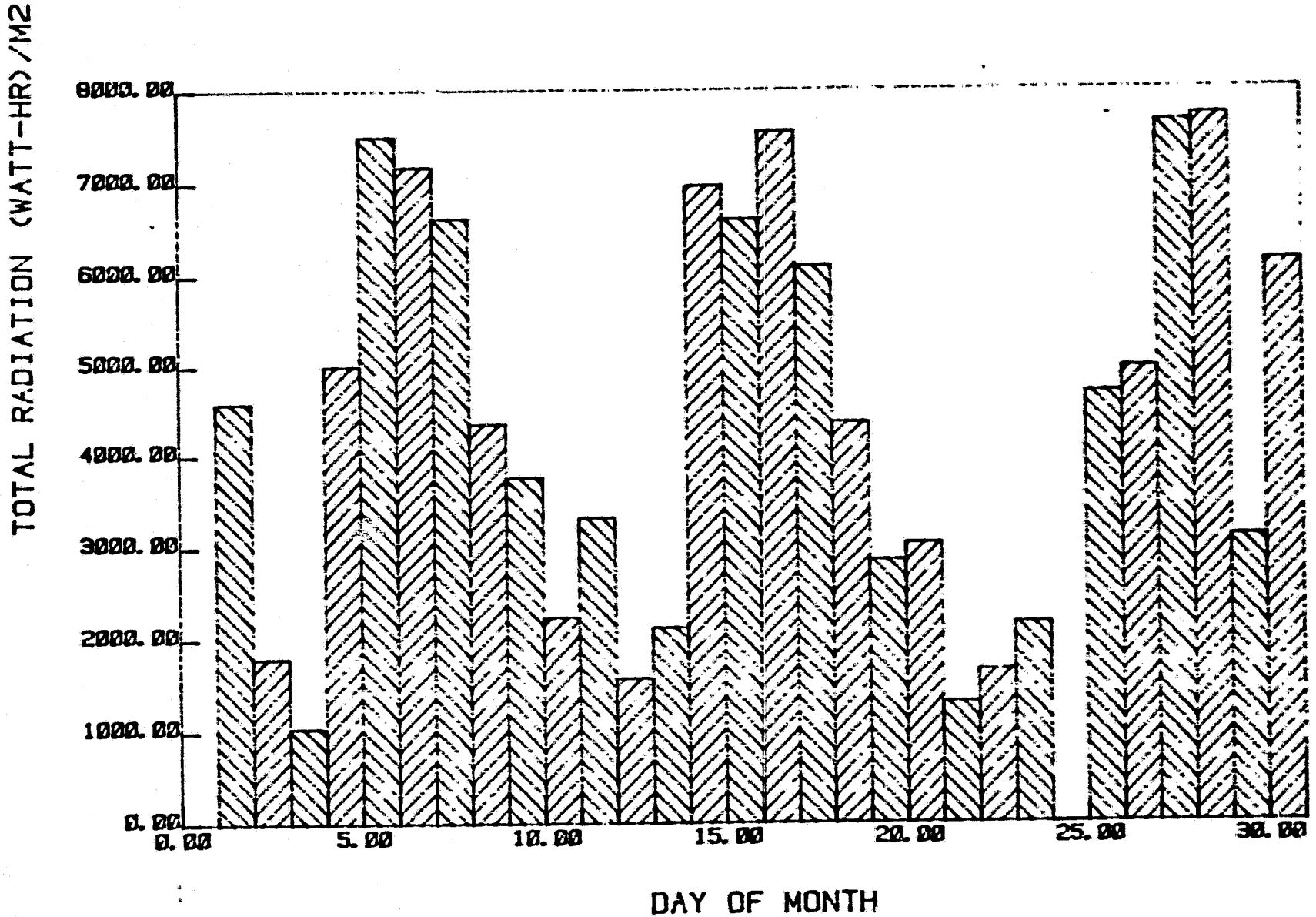

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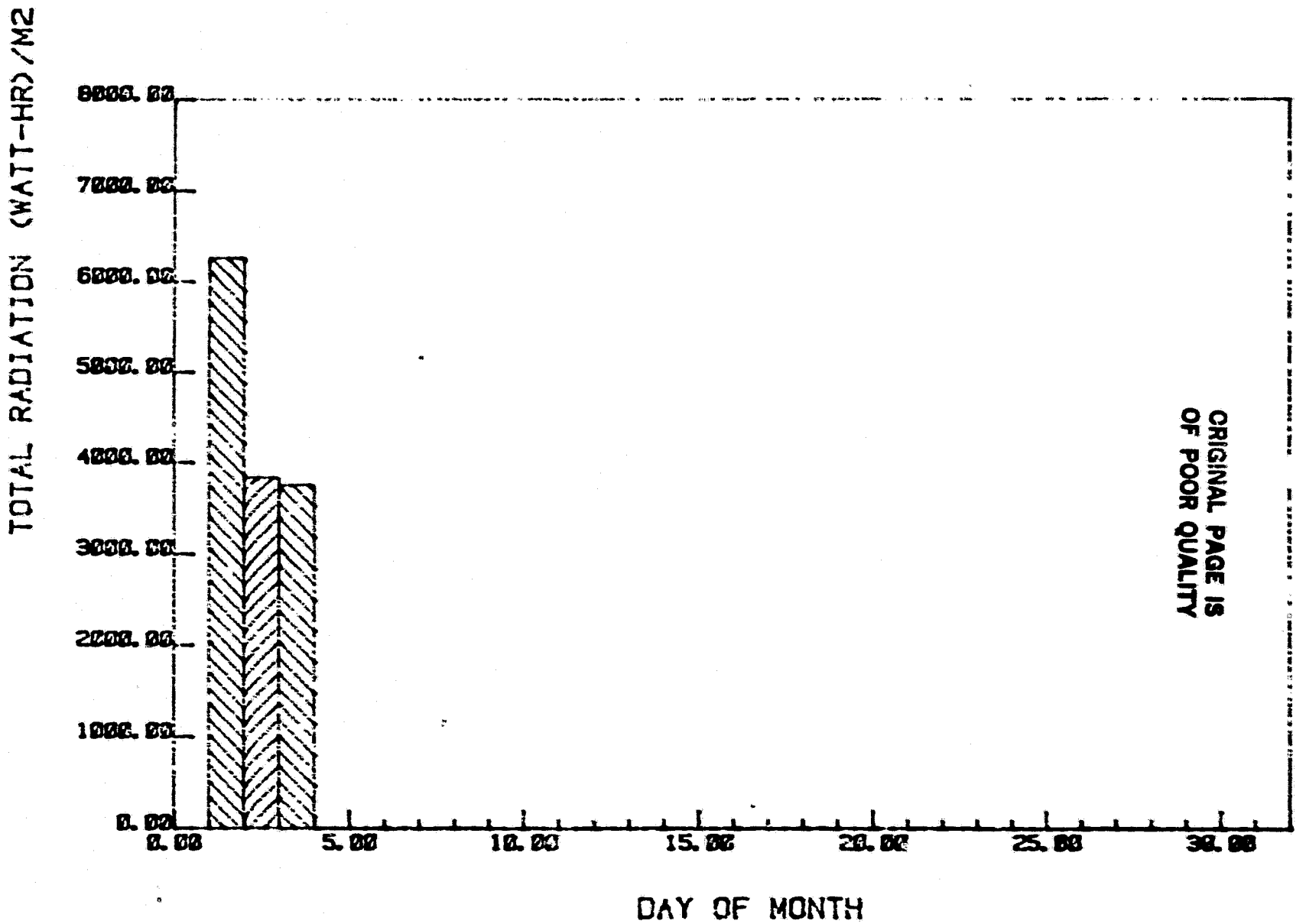

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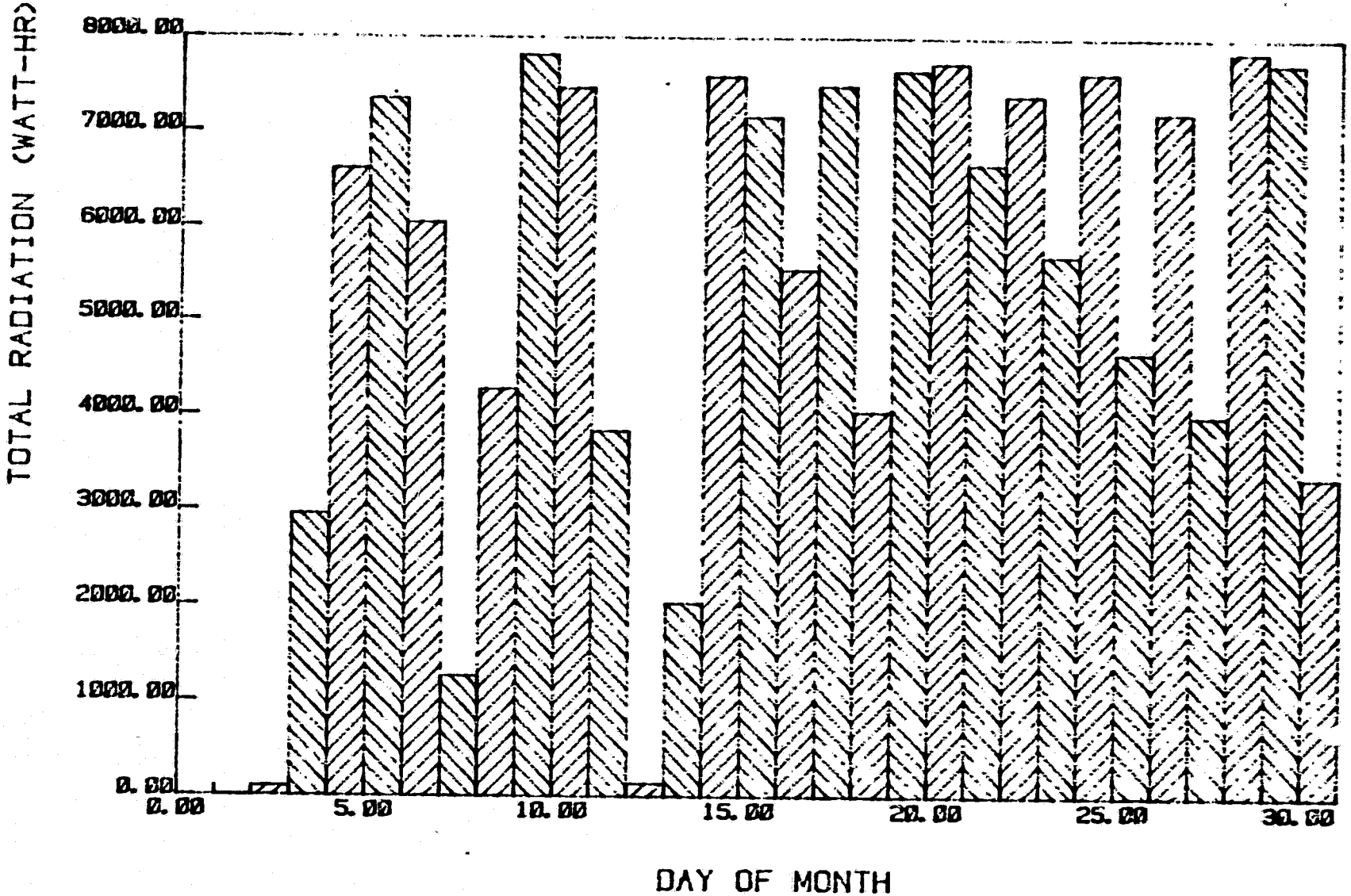

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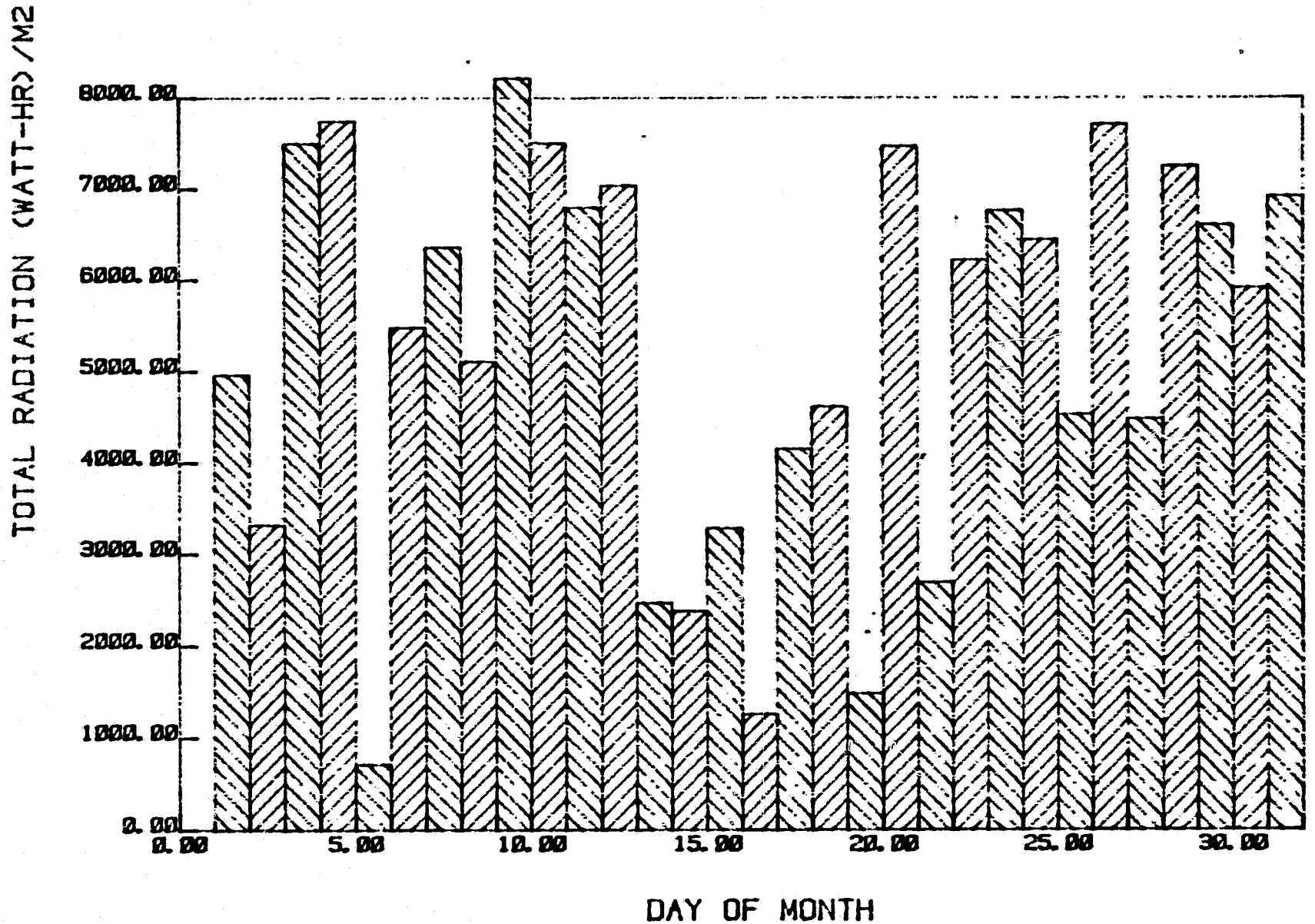

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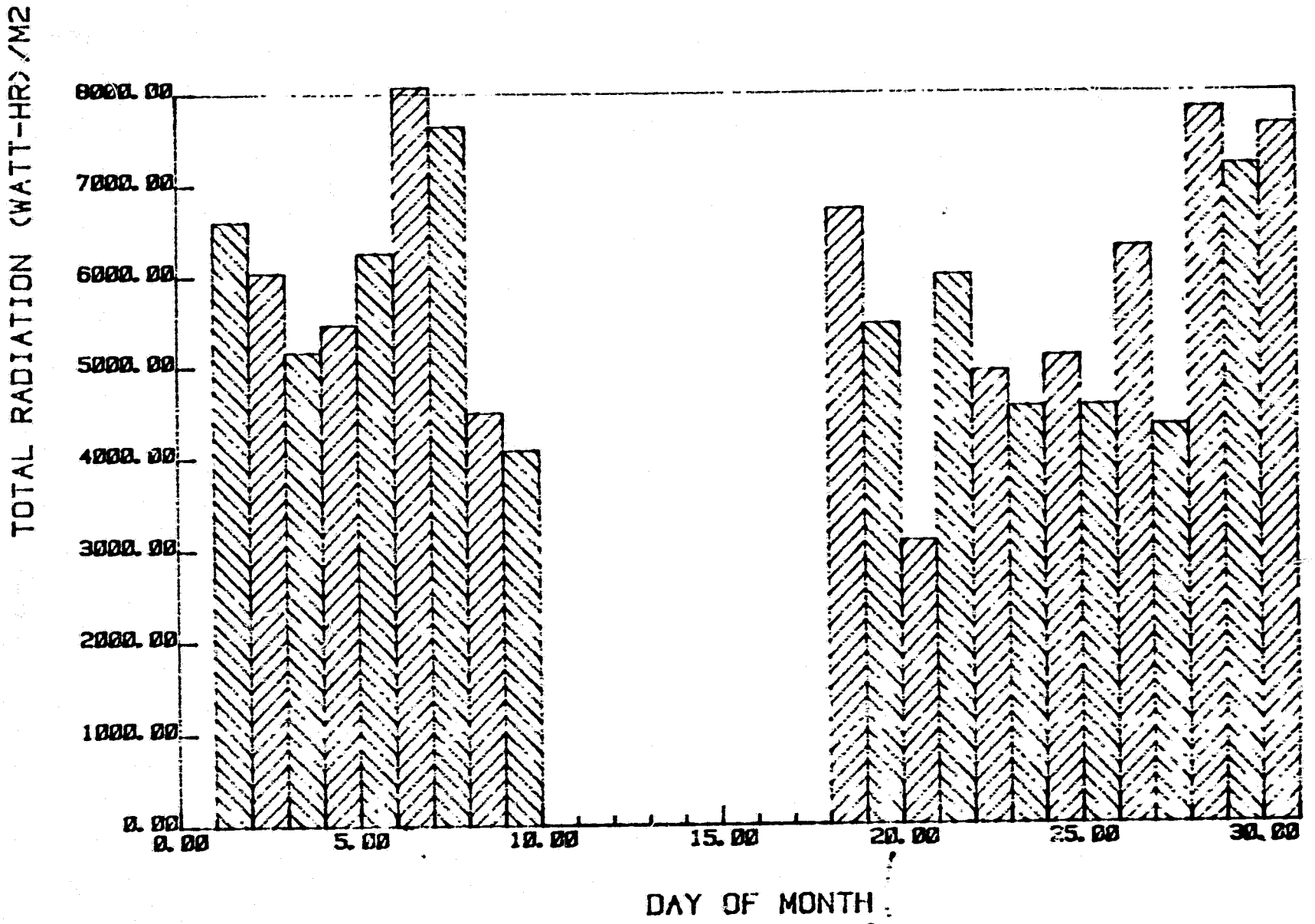

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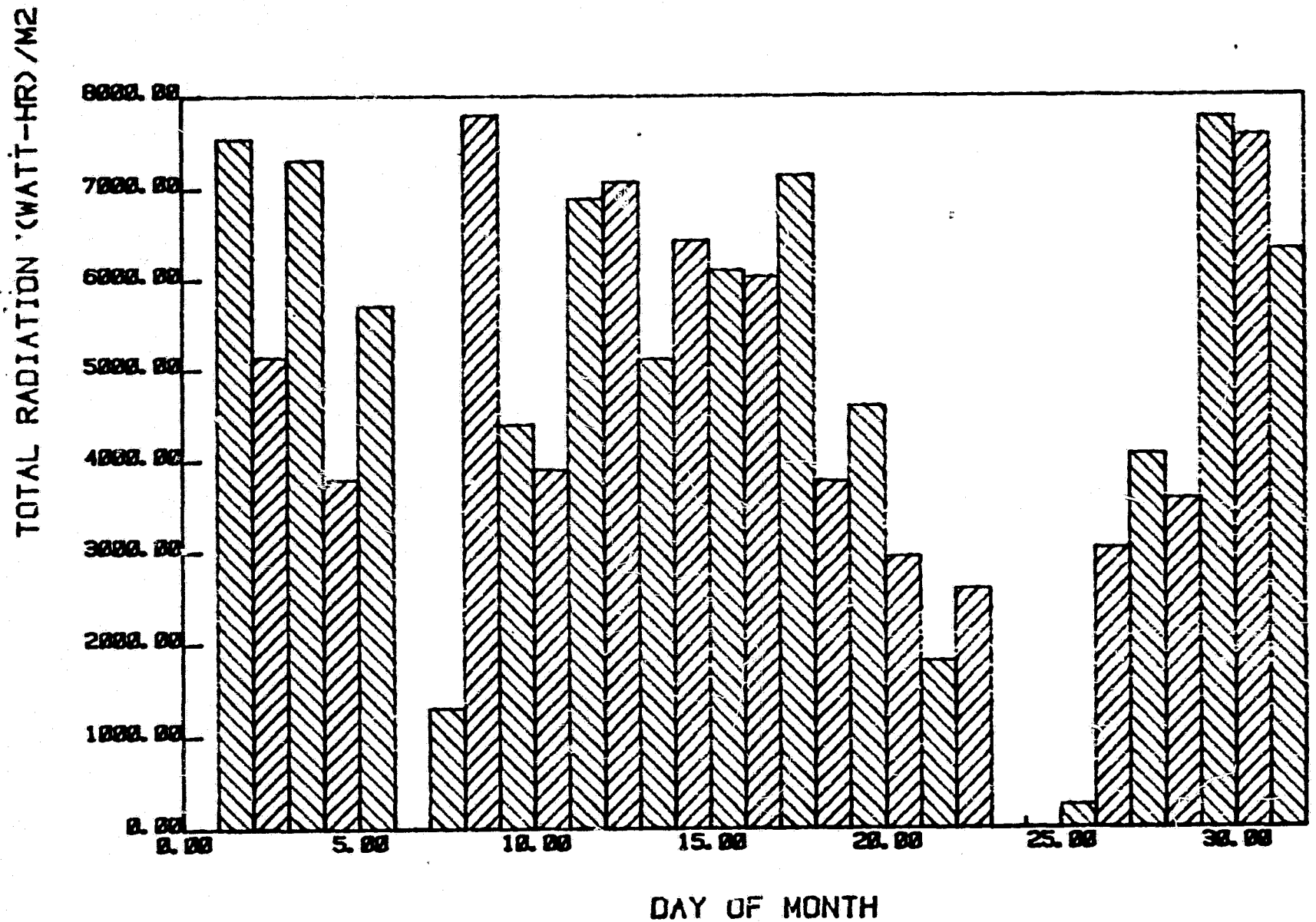

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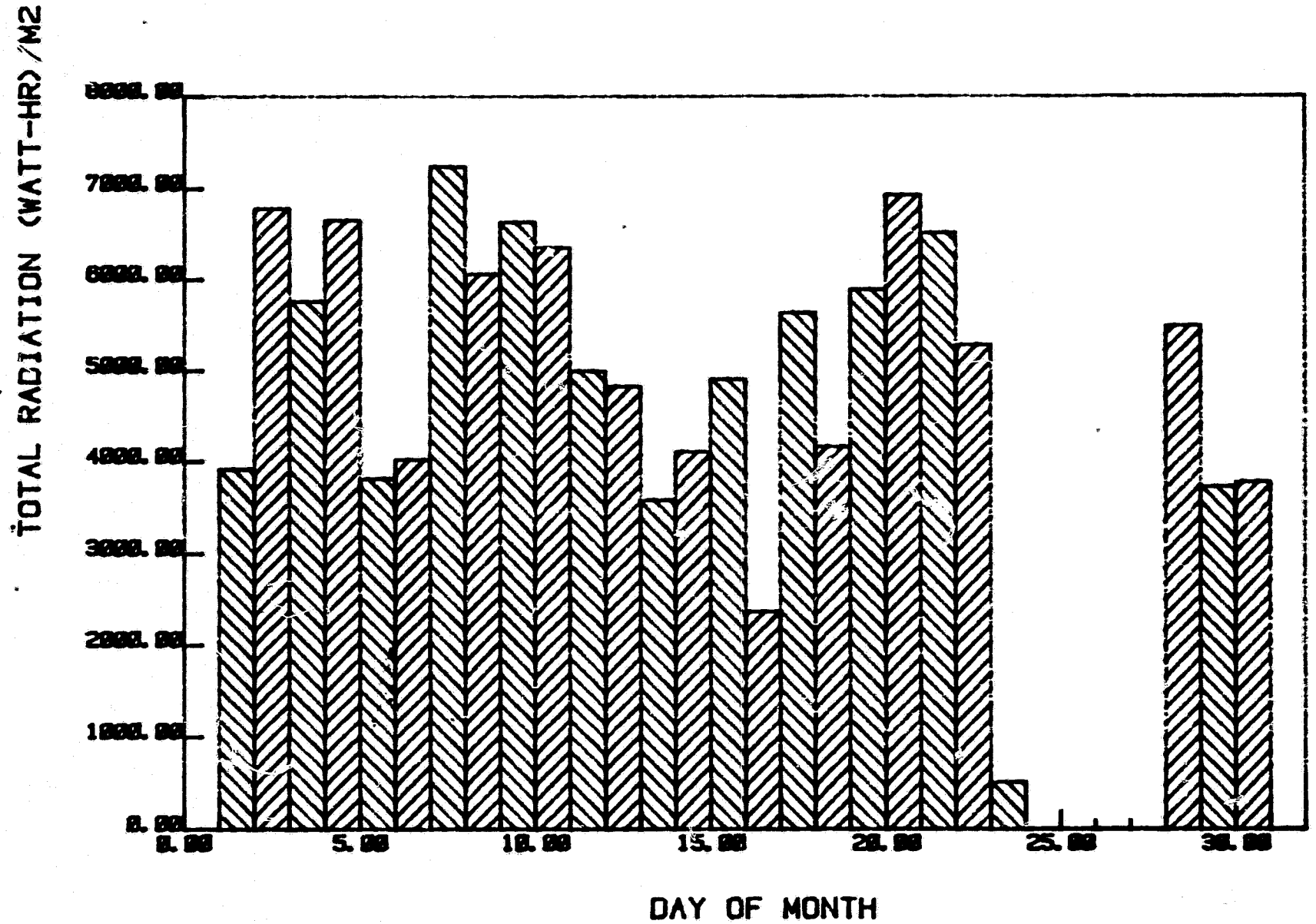

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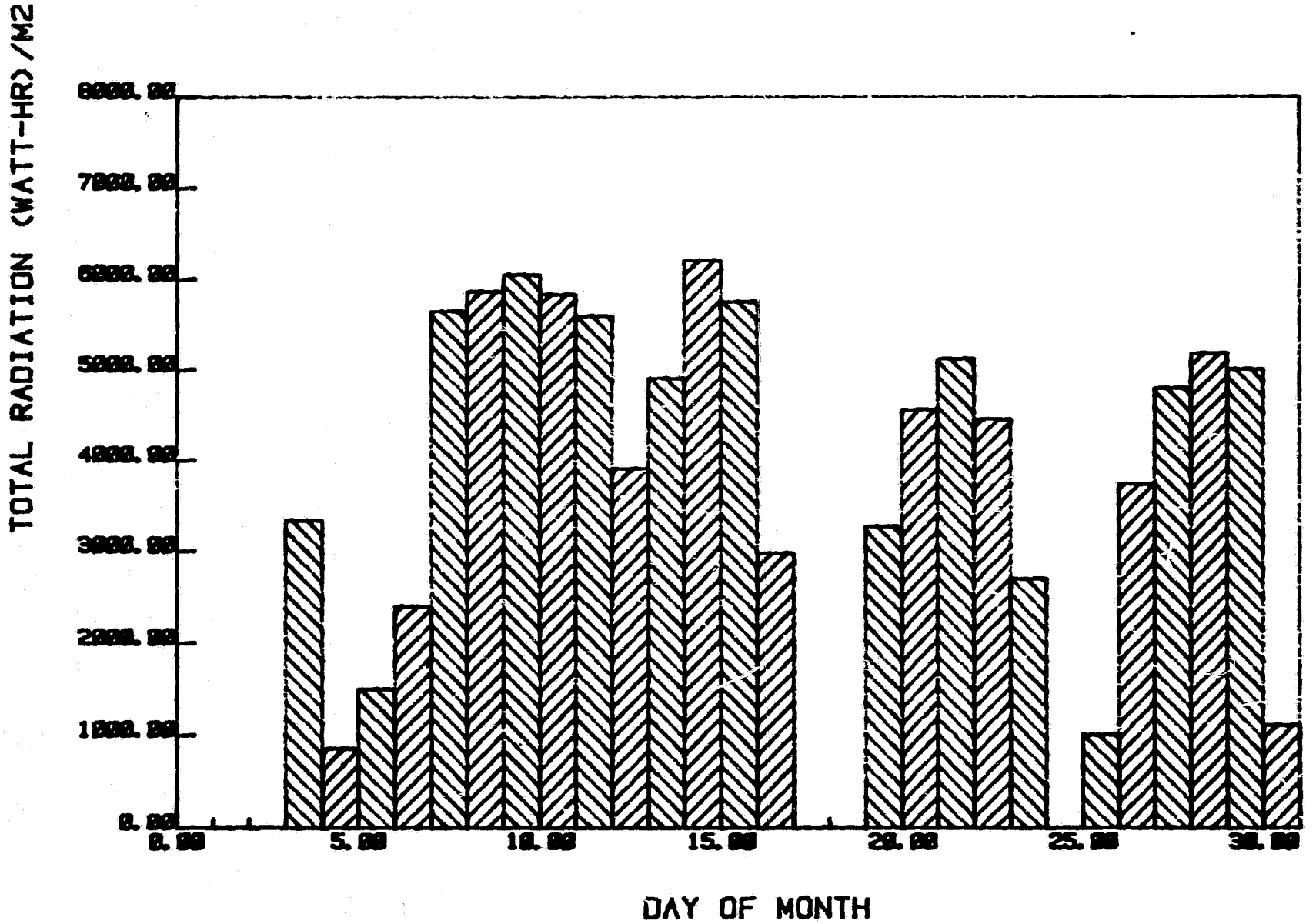

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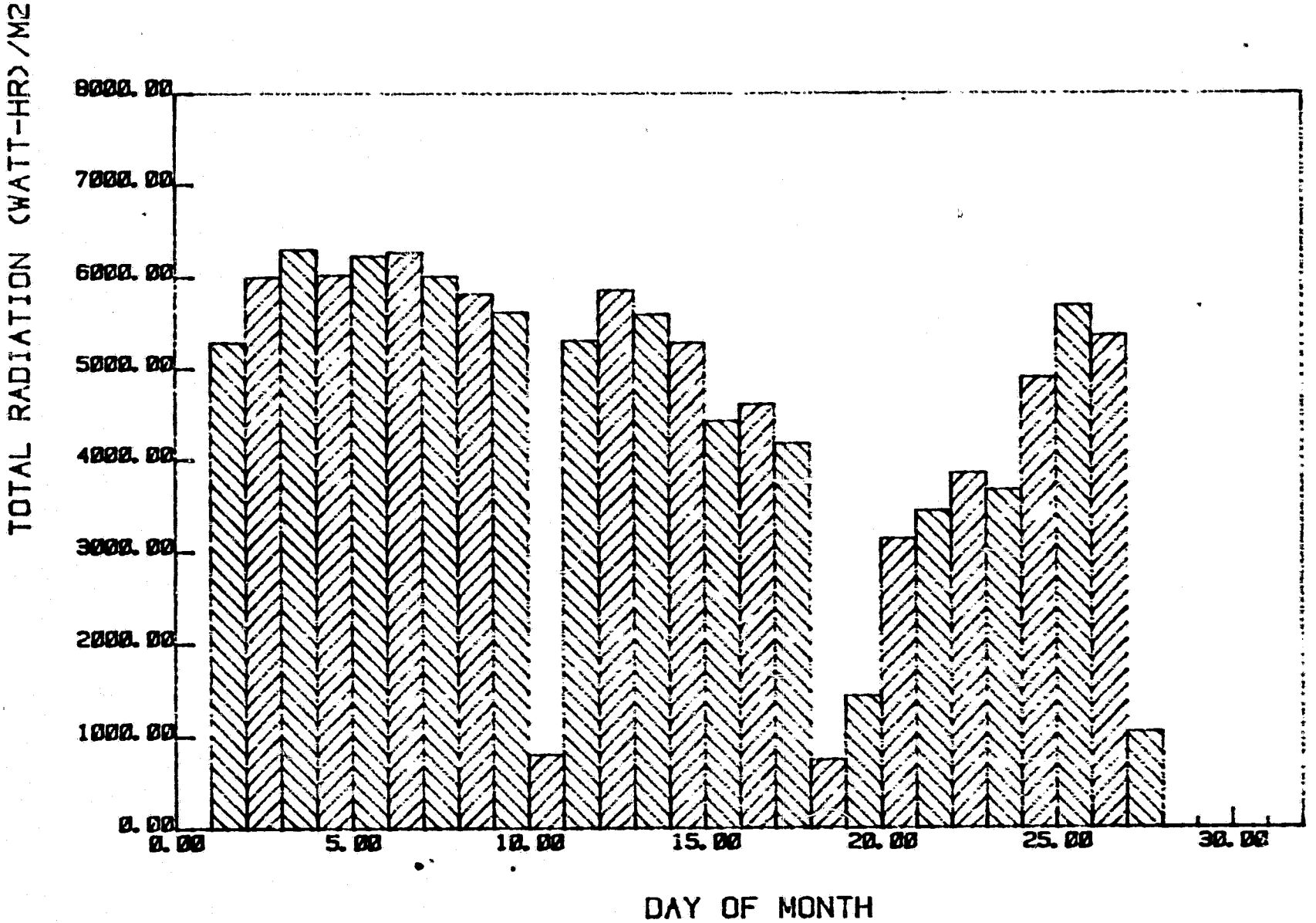

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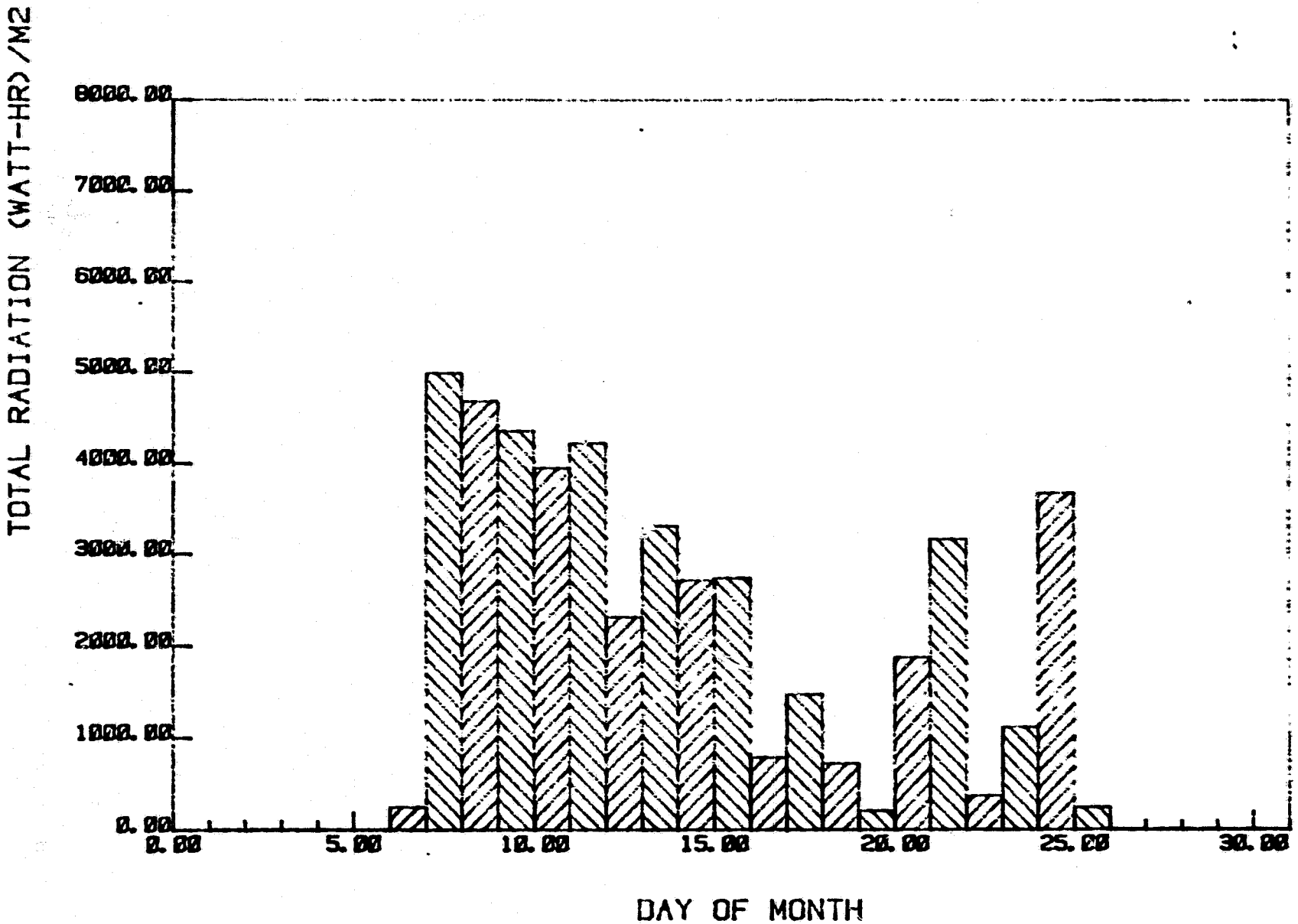

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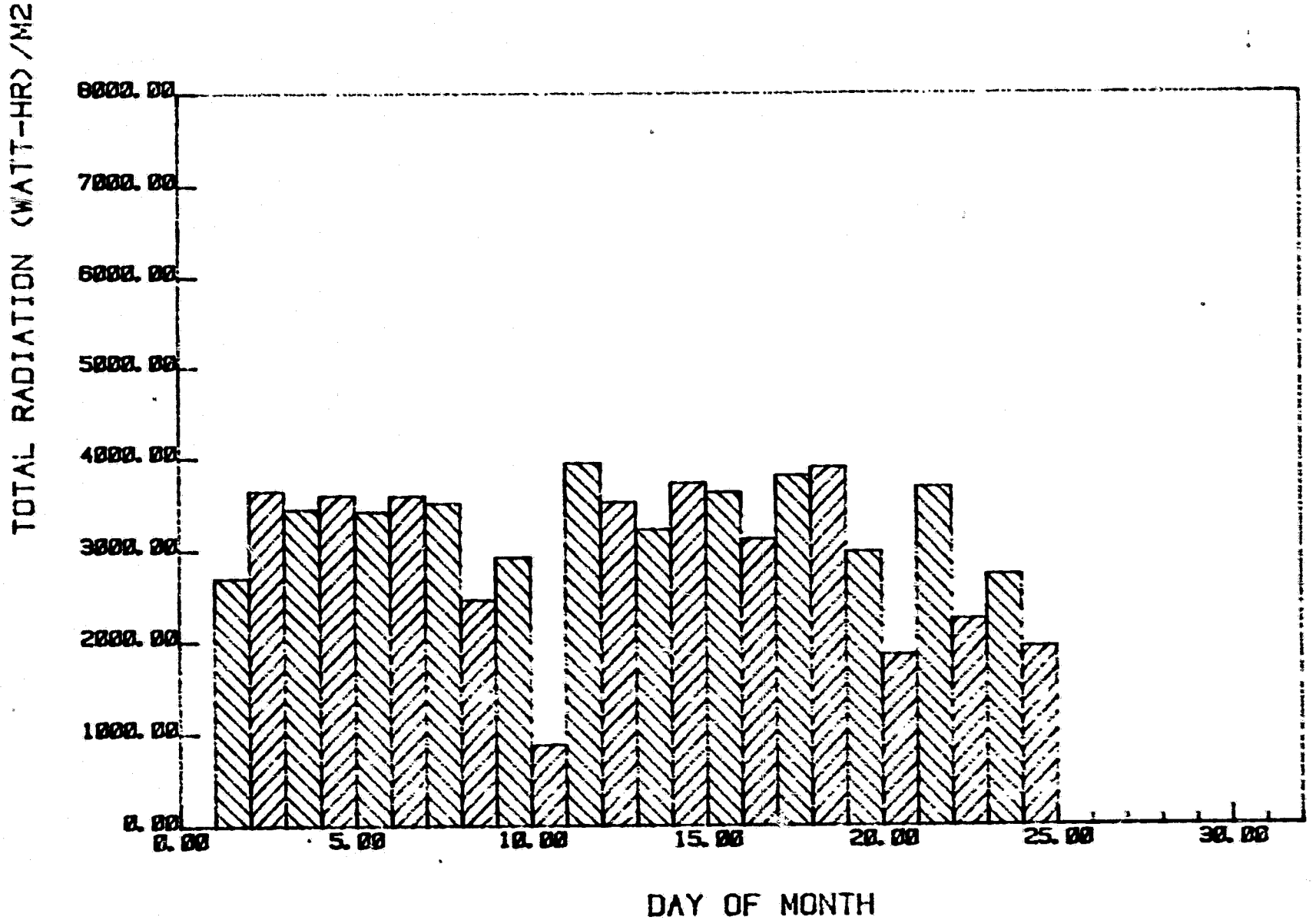

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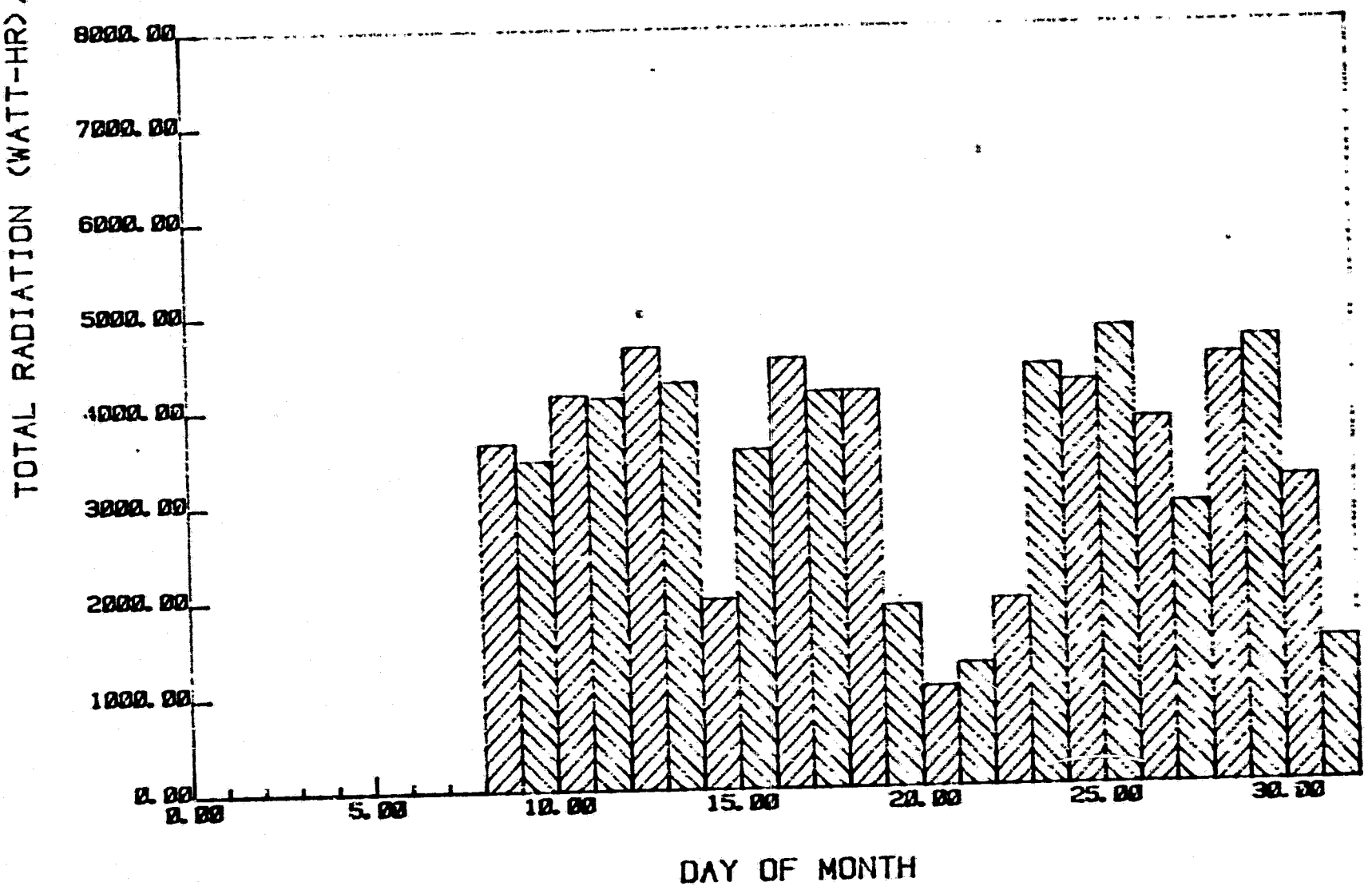

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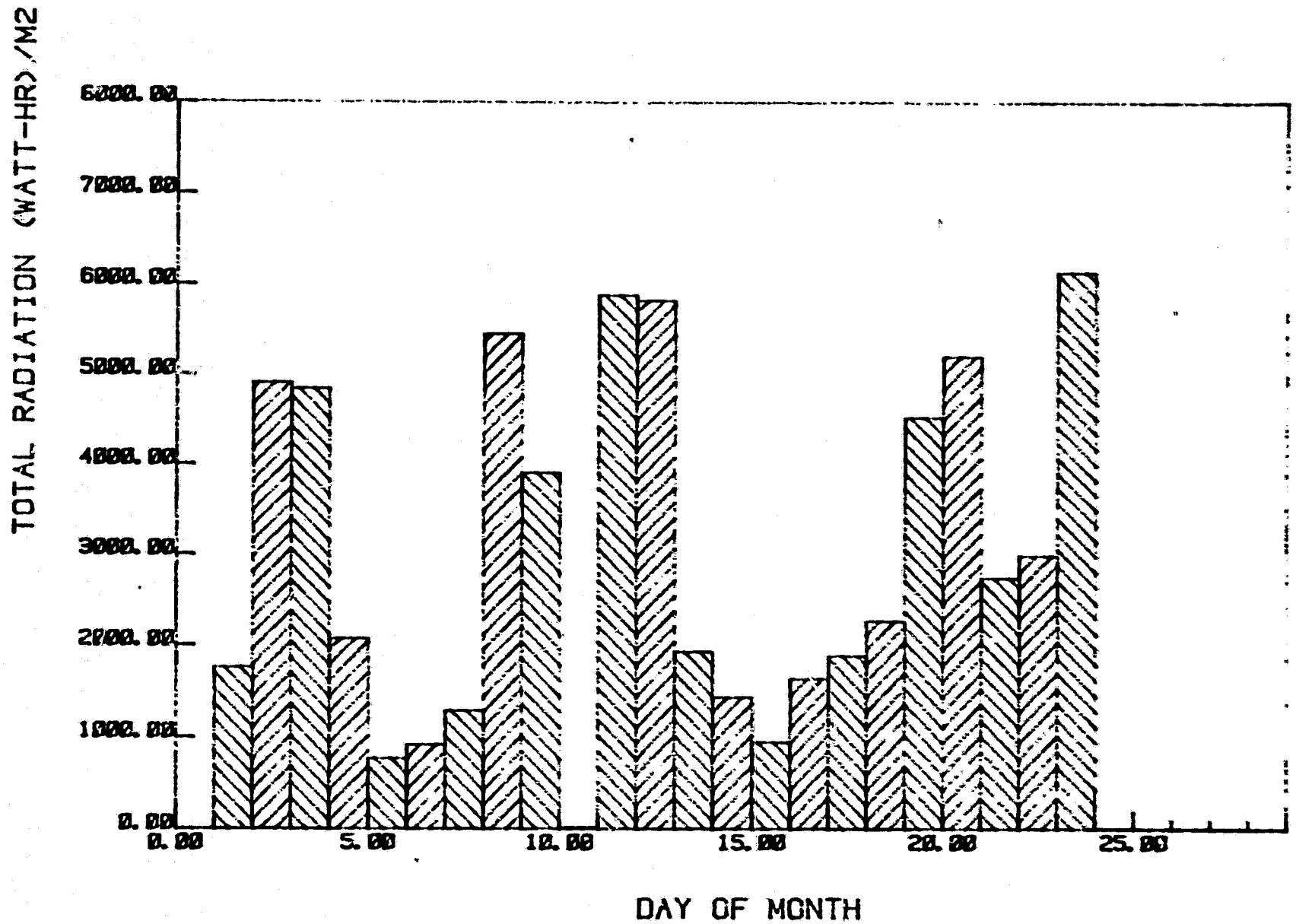

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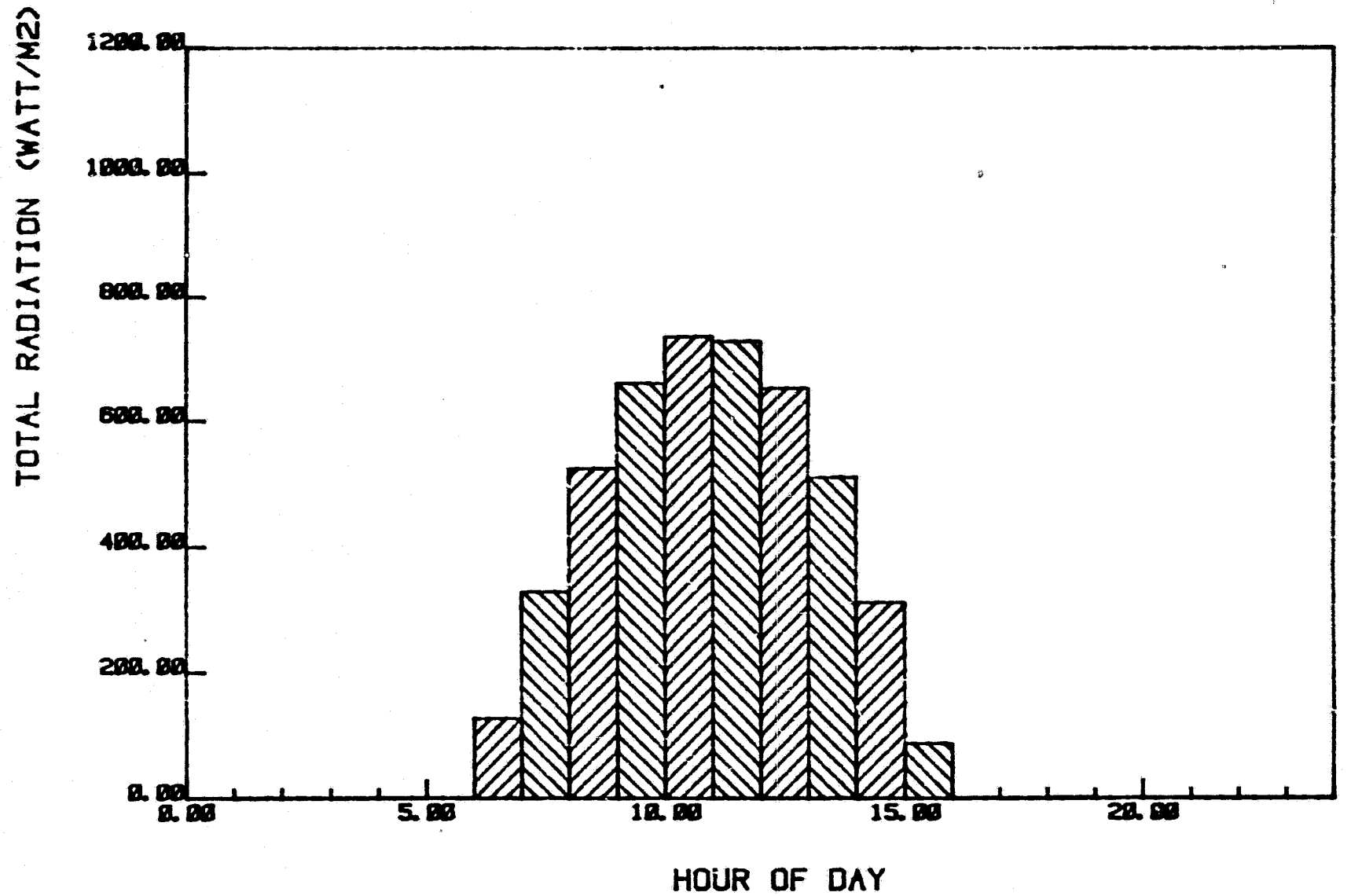

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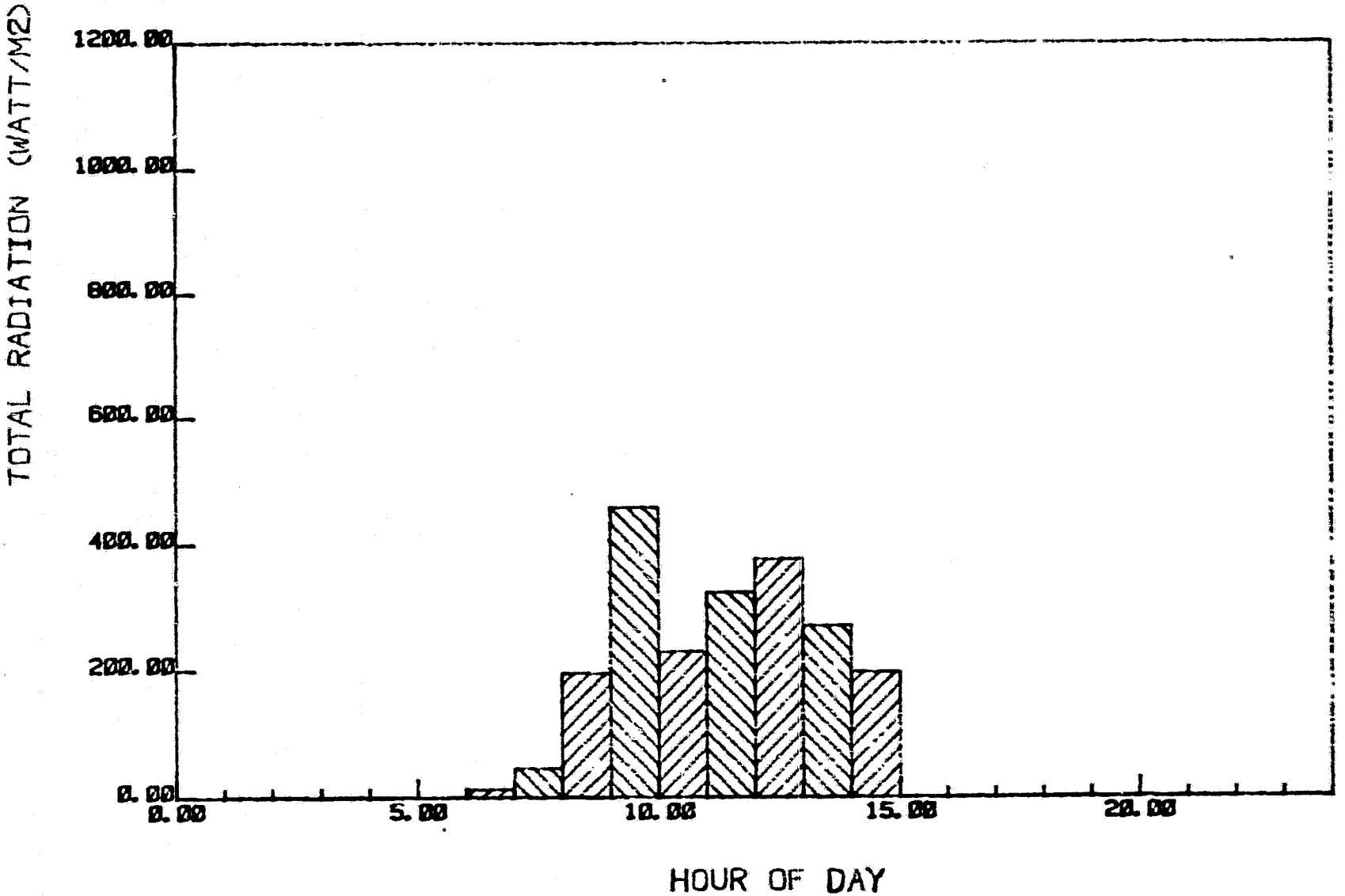

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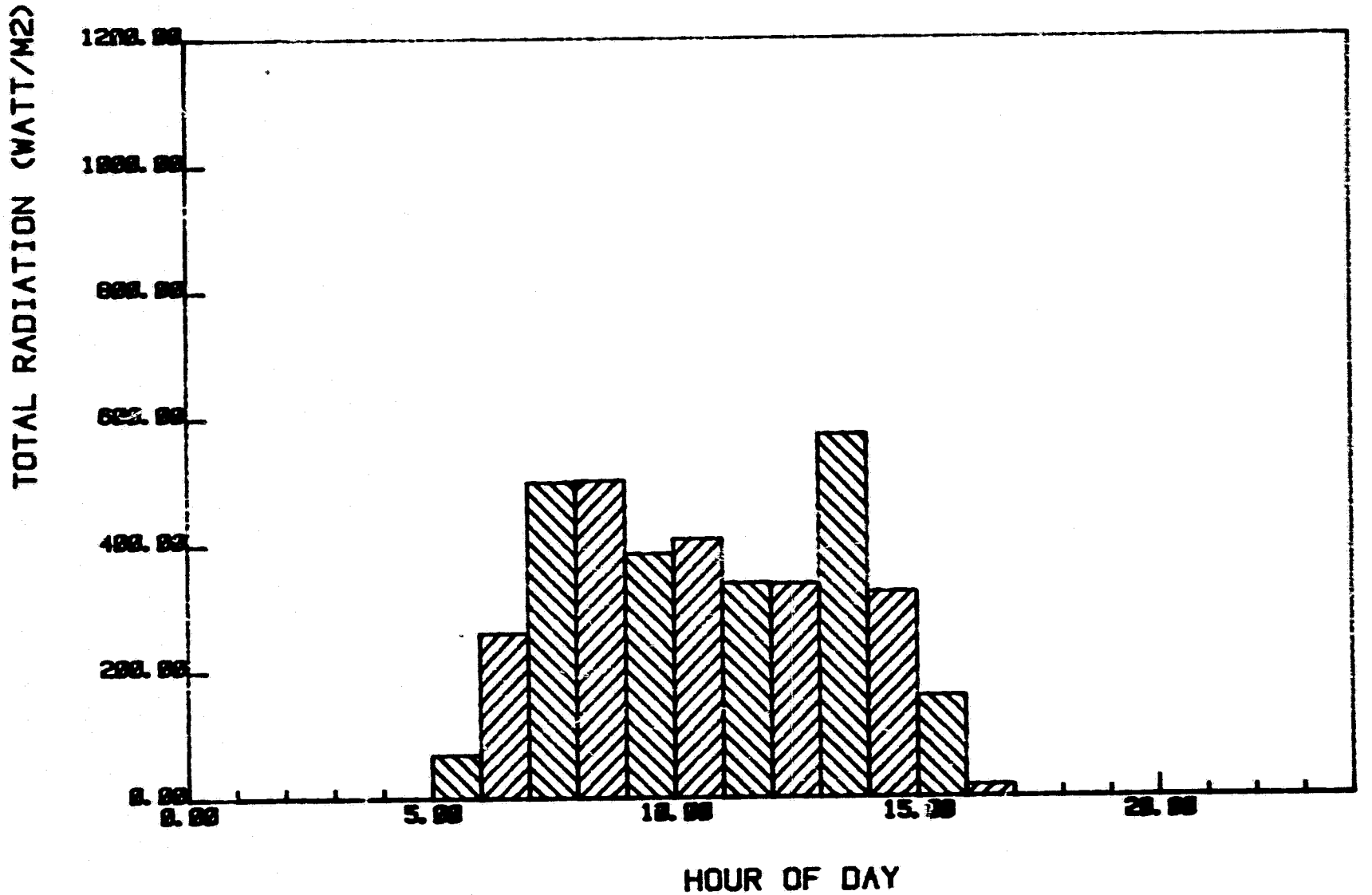

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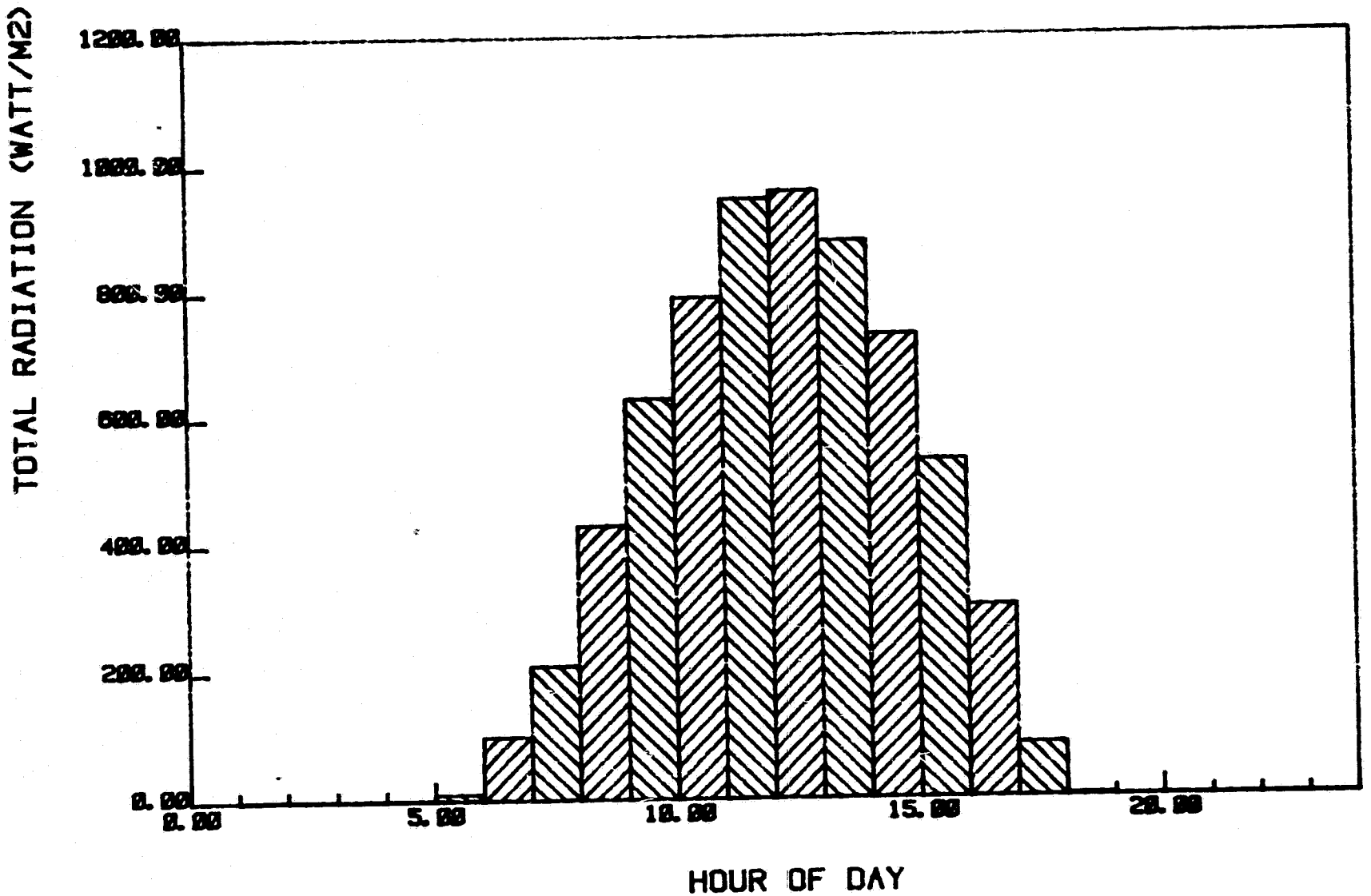

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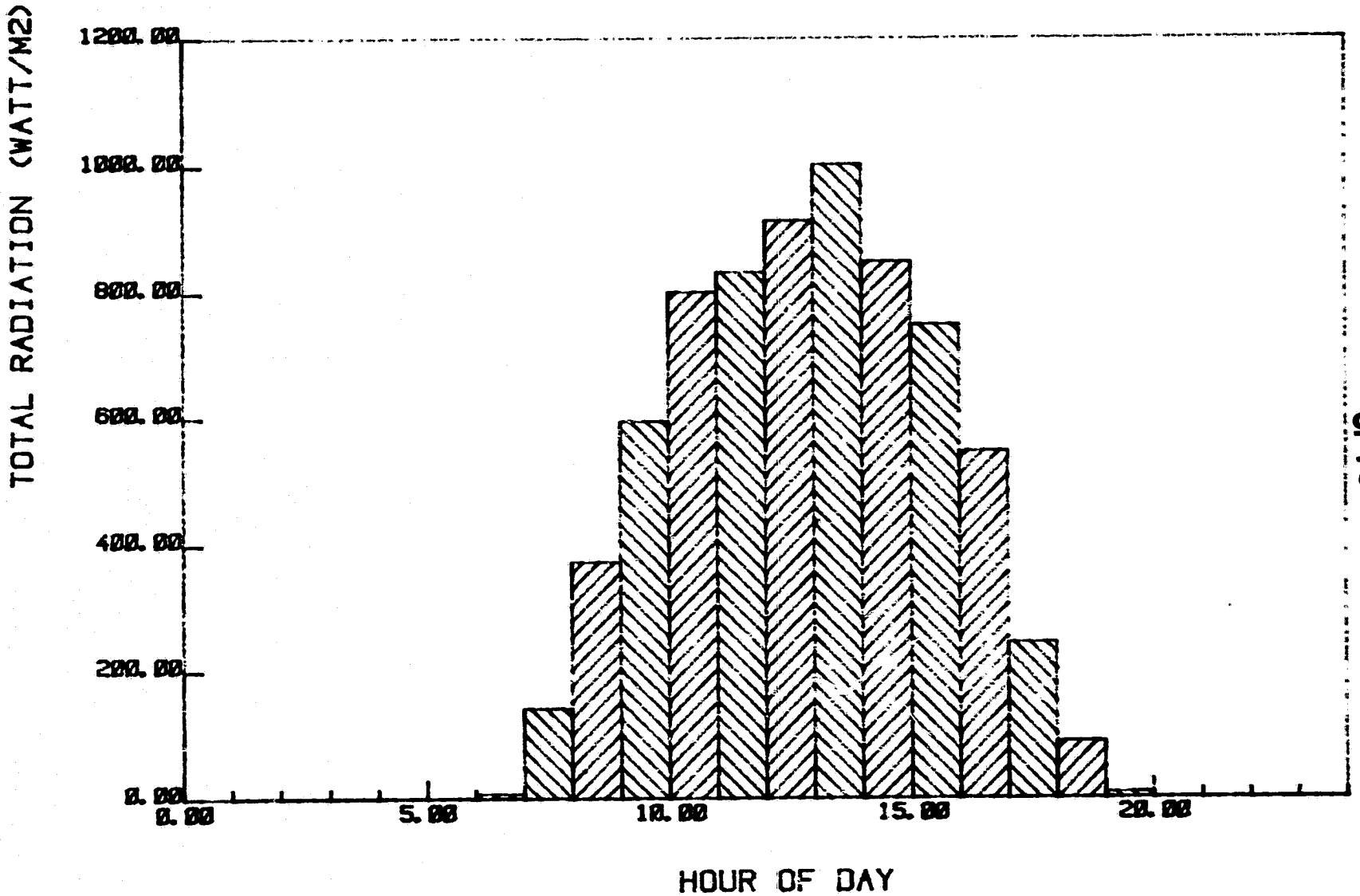

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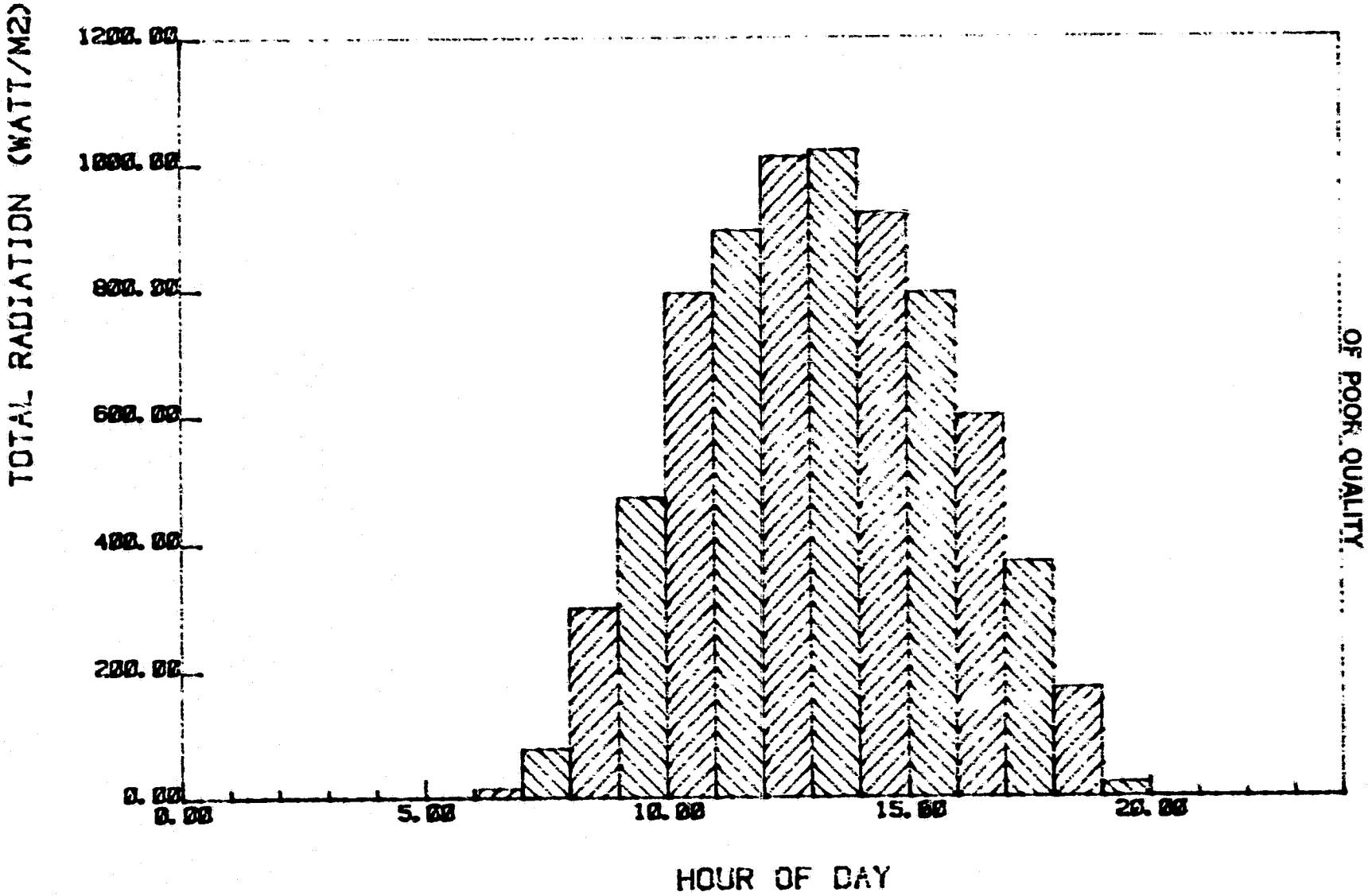

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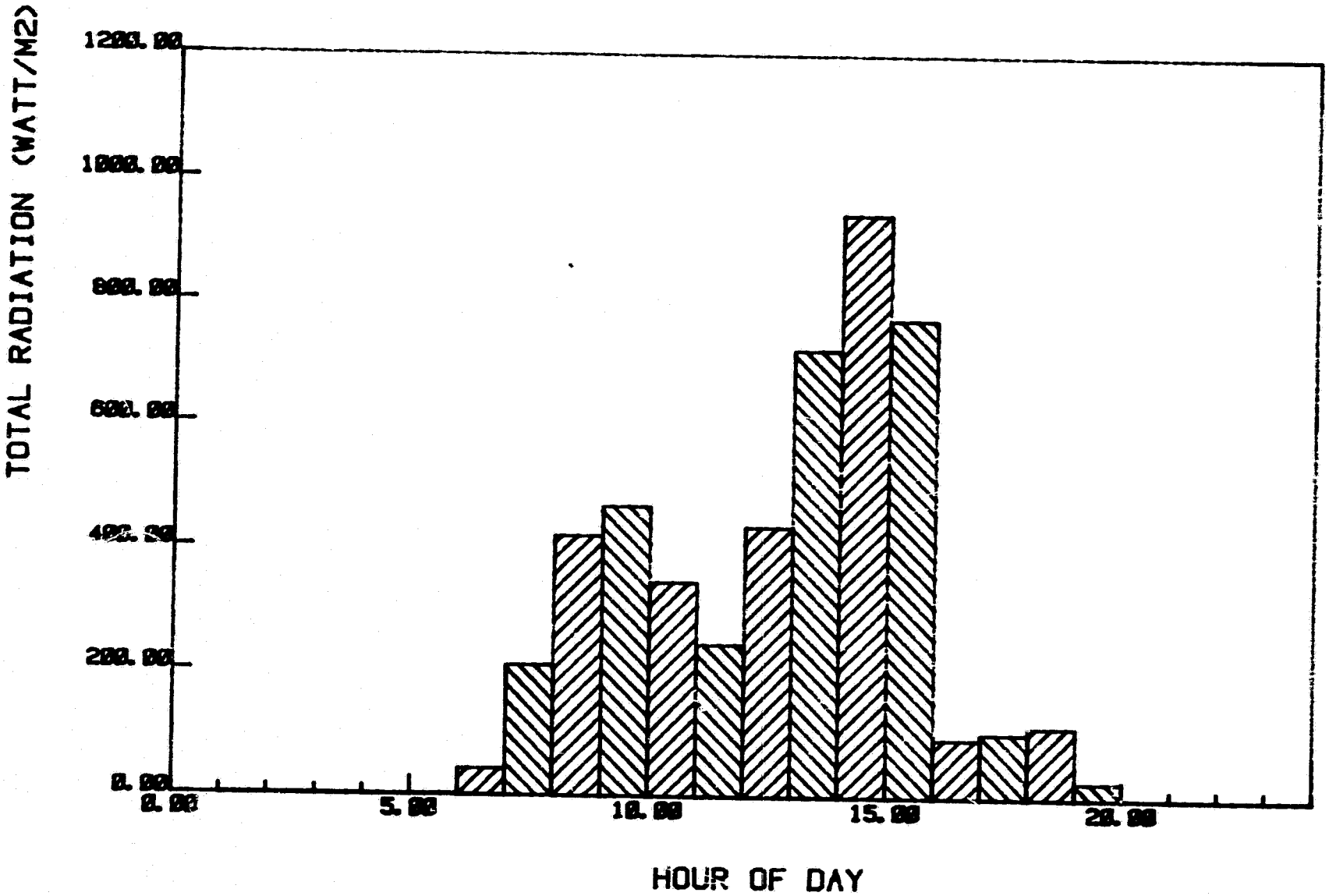

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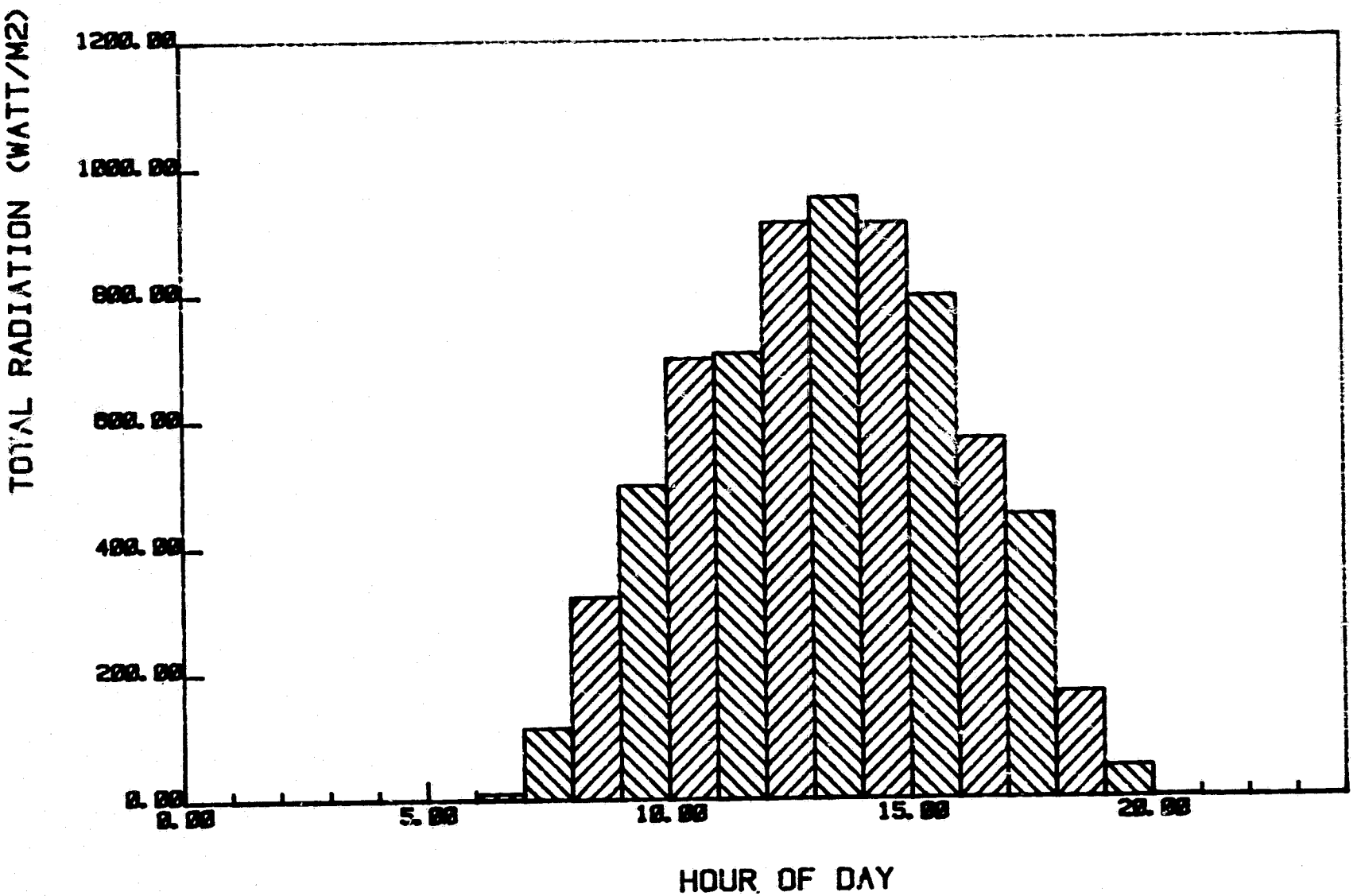

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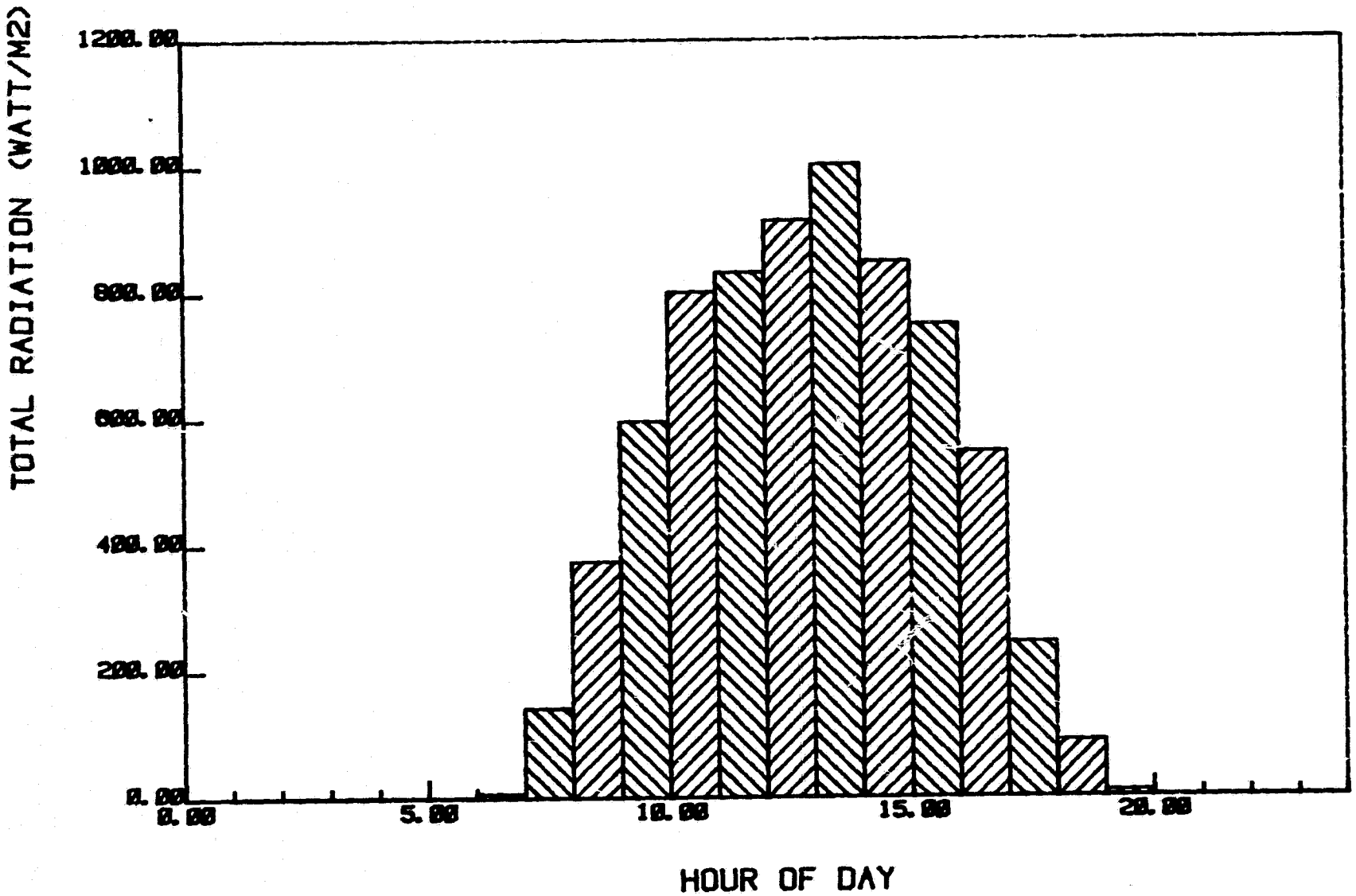

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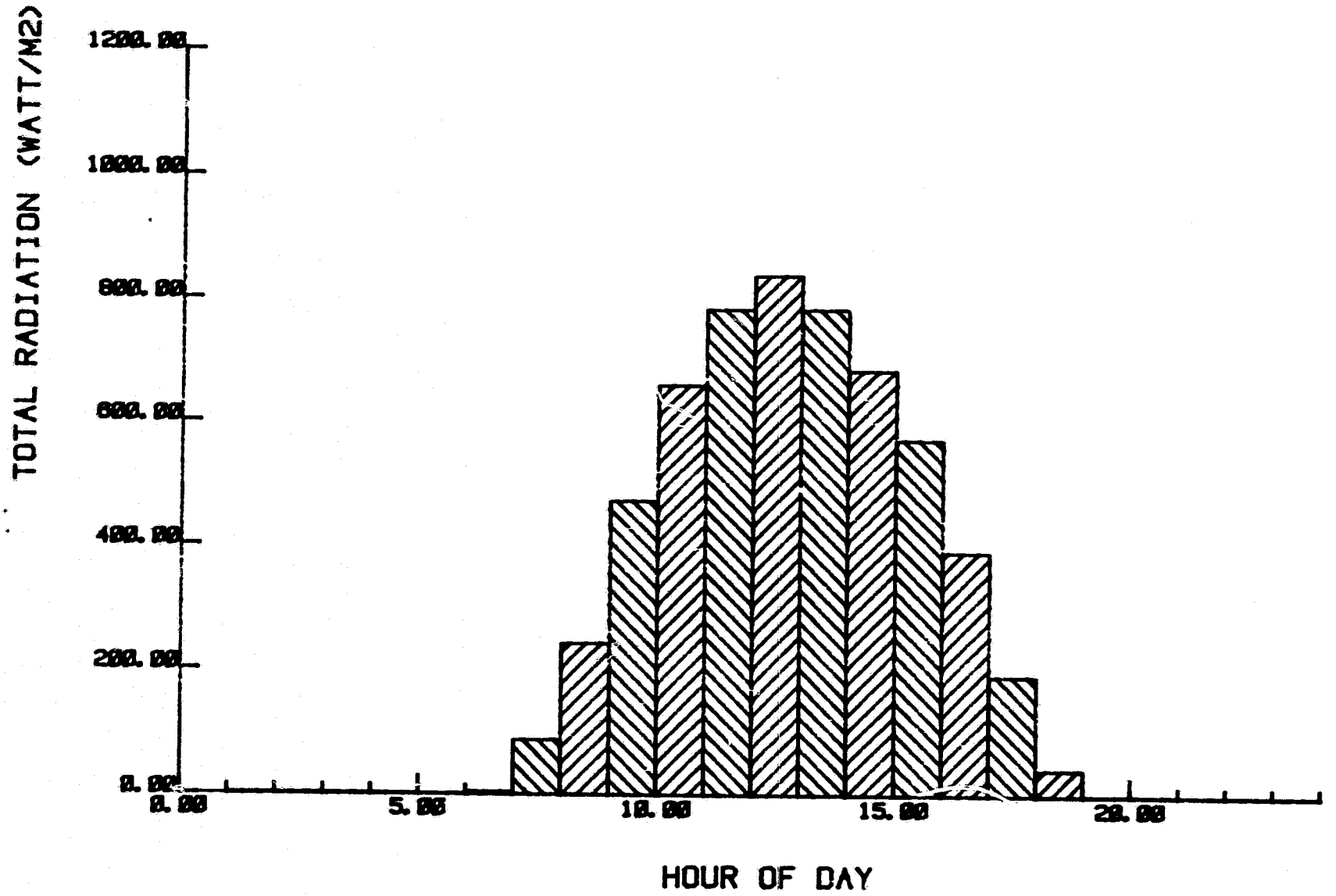

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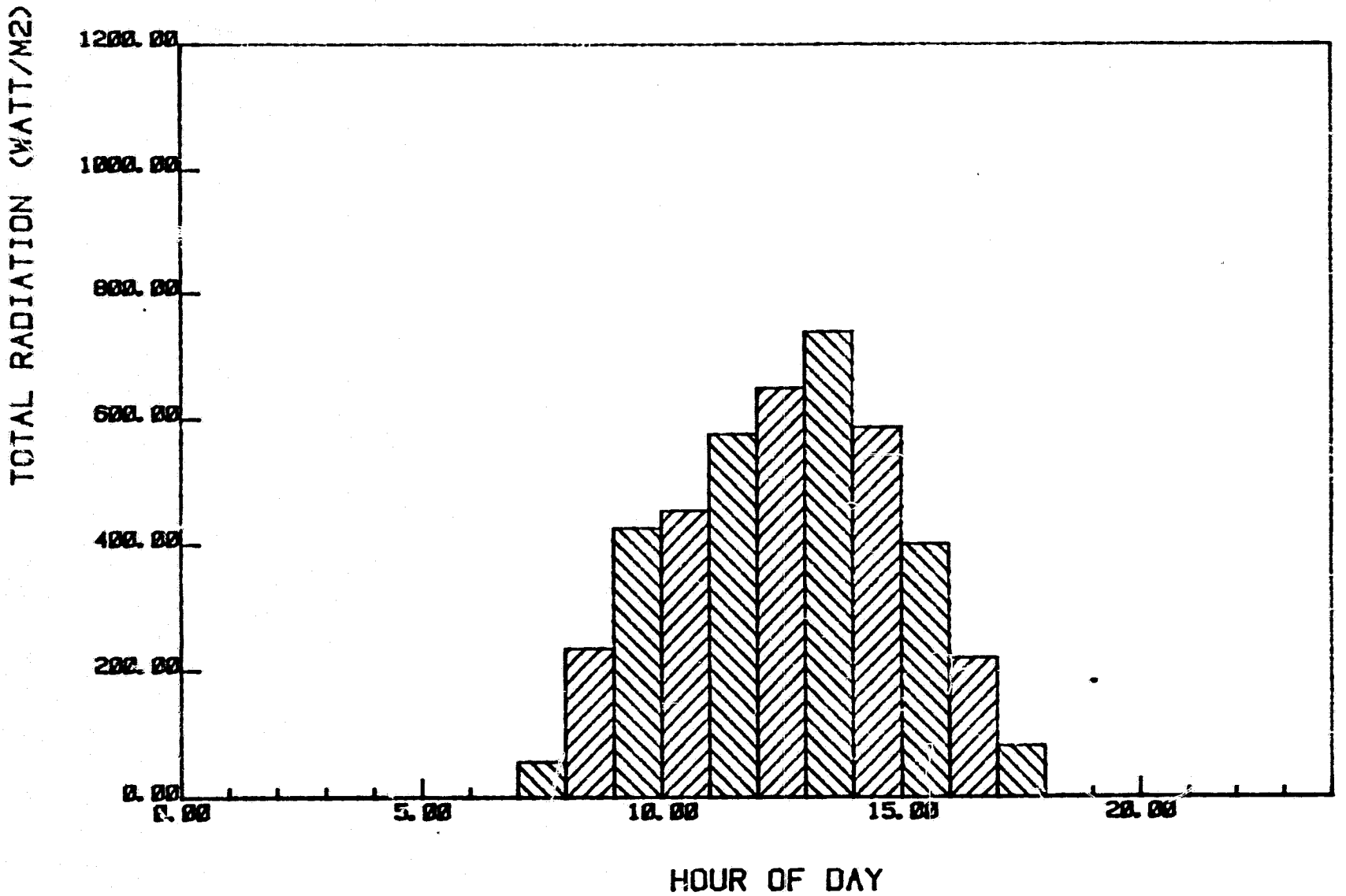

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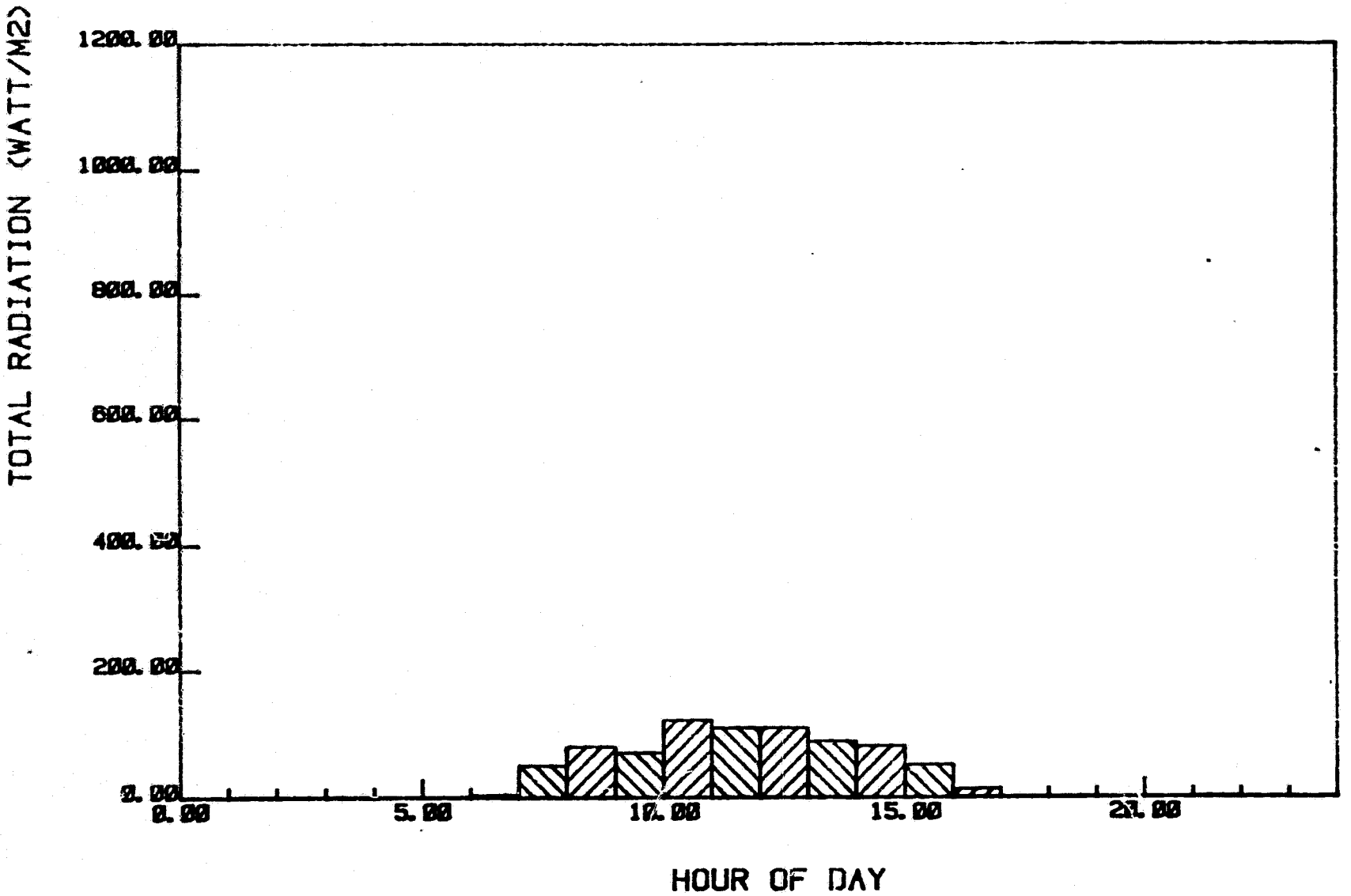

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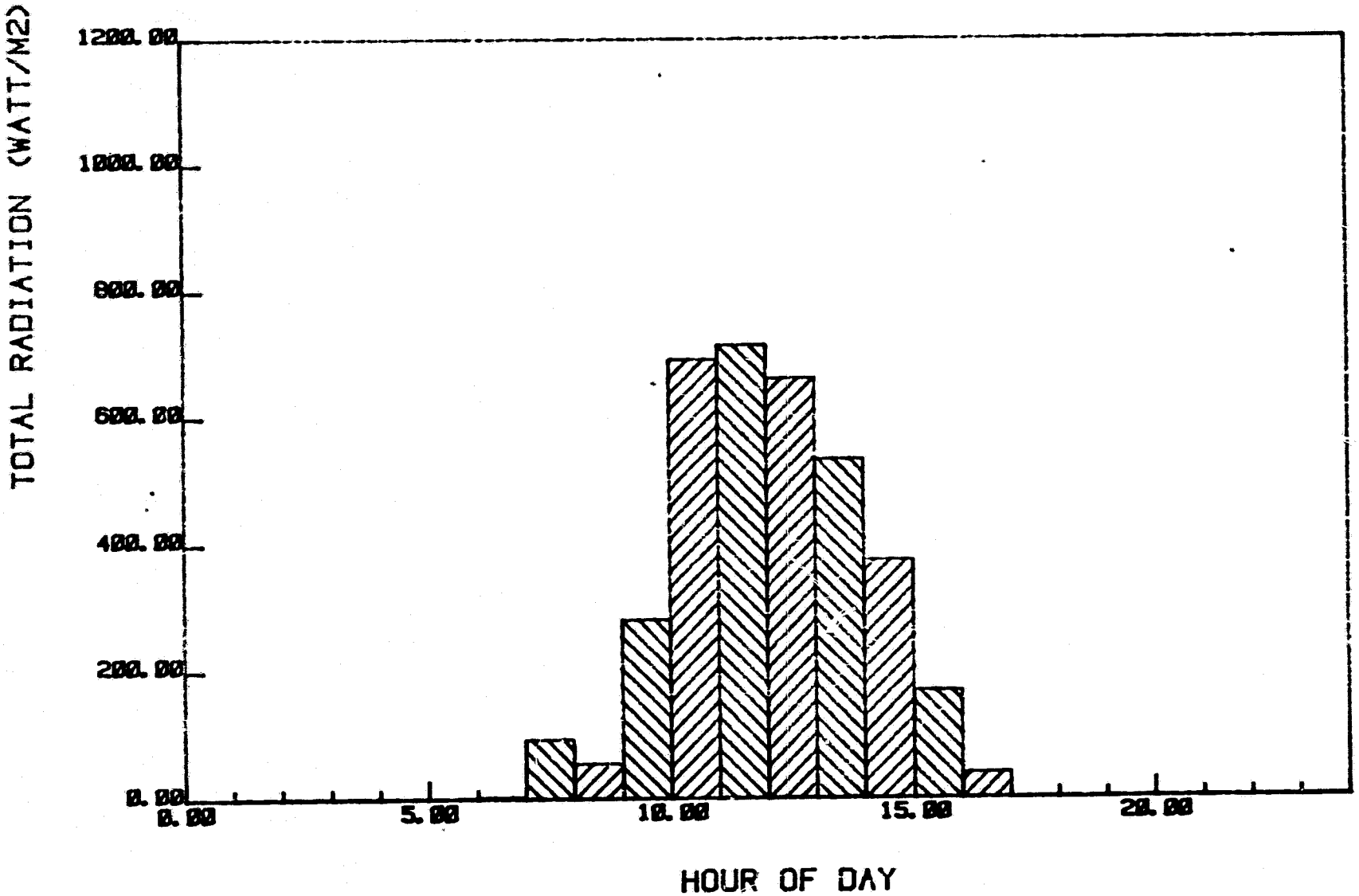

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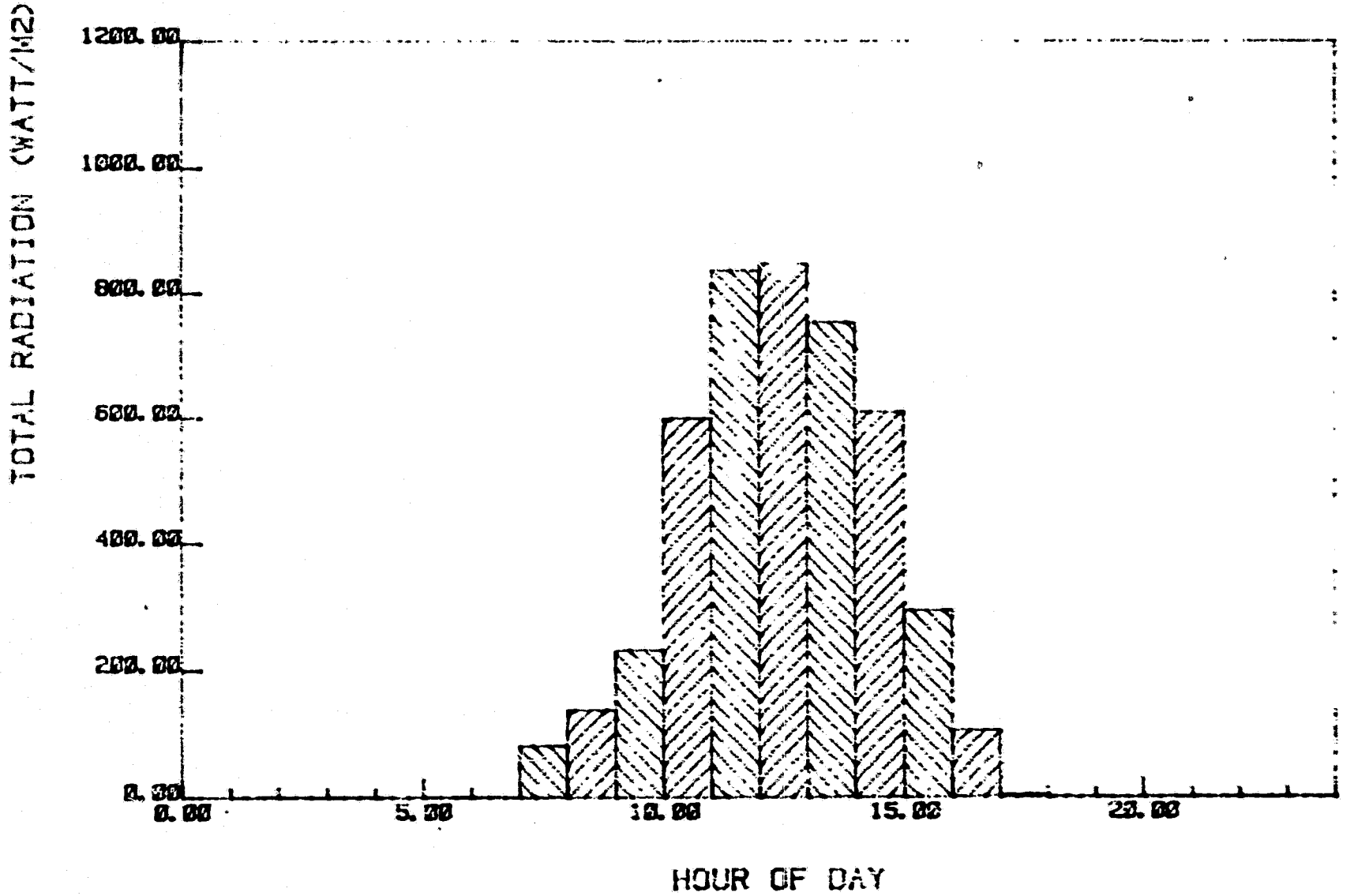

TOTAL - 15 FEB 1981