

THE ALLT A MHARCAIDH
HYDROLOGICAL DATA 1986

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and

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Report under contract to The Surface Water Acidification Programme

INTRODUCTION

This document is intended to illustrate the hydrology of the Allt a Mharcaidh catchment during 1986 and to simplify and summarise the hydrological data base for the catchment held at the Institute of Hydrology. It should enable SWAP participants to easily isolate periods of interest and as such will facilitate data exchange. Not all of the data collected by IH is illustrated here, in particular, the chemistry of rainfall and snowmelt, but it is assumed that rainfall-runoff and meteorological responses will be of most interest to all co-operating workers within the programme.

Finally, the data illustrated here should under no circumstances be reproduced without consultation with the SWAP co-ordinator at IH as care needs to be exercised in its interpretation in many cases.

(1) WATER BALANCE

An input-output analysis has been undertaken for 1986 and given the difficulties experienced with monitoring inputs from snowmelt and, at present, the lack of a good estimate of evapotranspiration, the figures would appear to be acceptable for a study of this sort (i.e. bearing in mind that this is effectively a hydro-chemical study and not a purely hydrological study). The water budget is as follows:

Stream outflow (measured) = 925 mm

Rainfall input (measured) = 850 mm

Evapotranspiration (estimated at 15%) = 139 mm

Clearly the balance here of 214 mm (i.e. input = 850 mm and output = 1064 mm) can only be made up from snow inputs. This balance ties in well with the measured estimate of snow input carried out by the University of Stirling of 290 mm.

(2) RUNOFF DATA

Stream stage is monitored at 20 min intervals at the catchment outflow and converted to discharge using the stage-discharge relationship shown in

figure 2, constructed by dilution gauging. Flows above the highest spot gauging are simple extrapolations of the curve and as such may be subject to severe inaccuracies. The discharge record, together with the 20 minute temperature, pH and conductivity record, is shown on a monthly basis in Appendix A. The flow duration curve shown in figure 3 is constructed from the 20 minute instantaneous data and is characteristic of a 'flashy' basin with relatively thin soils, impermeable granitic bedrock and steep slopes (average main channel slope = 1:10, drainage density = 1.45 km. km⁻²). High flows, greater than 1 m³ s⁻¹, were experienced only 4% of the time.

Also shown in figure 3 is the H⁺ ion duration curve constructed from the instantaneous pH data. This is equally steep indicating that 'acid pulses' are severe but short lived with H⁺ ion concentration above 1 μeq l⁻¹ (pH = 6.0) for only 22% of the time. The 'flashy' nature of the H⁺ and flow duration curves indicates that a strong relationship exists between H⁺ and flow and this is further demonstrated by the graphical analysis in Appendix A.

(3) RAINFALL DATA

Rainfall is monitored as an hourly intensity at six sites within the catchment although only five are described here. The other is treated in the section describing meteorological variables being an integral part of the automatic weather station. The siting of the six raingauges is shown in figure 1 and was largely determined by the necessity of proximity to the soil pit studies. Raingauges 1, 2 and 3 are at ground level and are surrounded by grids whilst 4, 5 and 6 are standard gauges standing some 12" off the ground. Derivation of a catchment average precipitation is complicated by the areal extent of the basin (9.87 km²) and by the altitudinal range (from 330 m at the catchment outflow to 1111 m at the summit of Sgoron Dubh Mor). An average catchment precipitation was estimated by employing a hypsometric method and a simple arithmetic mean of all 6 raingauges. On a monthly basis the two methods were within 4-6% variation and so for ease of calculation the simple average was assumed to be adequate for the purposes of this document.

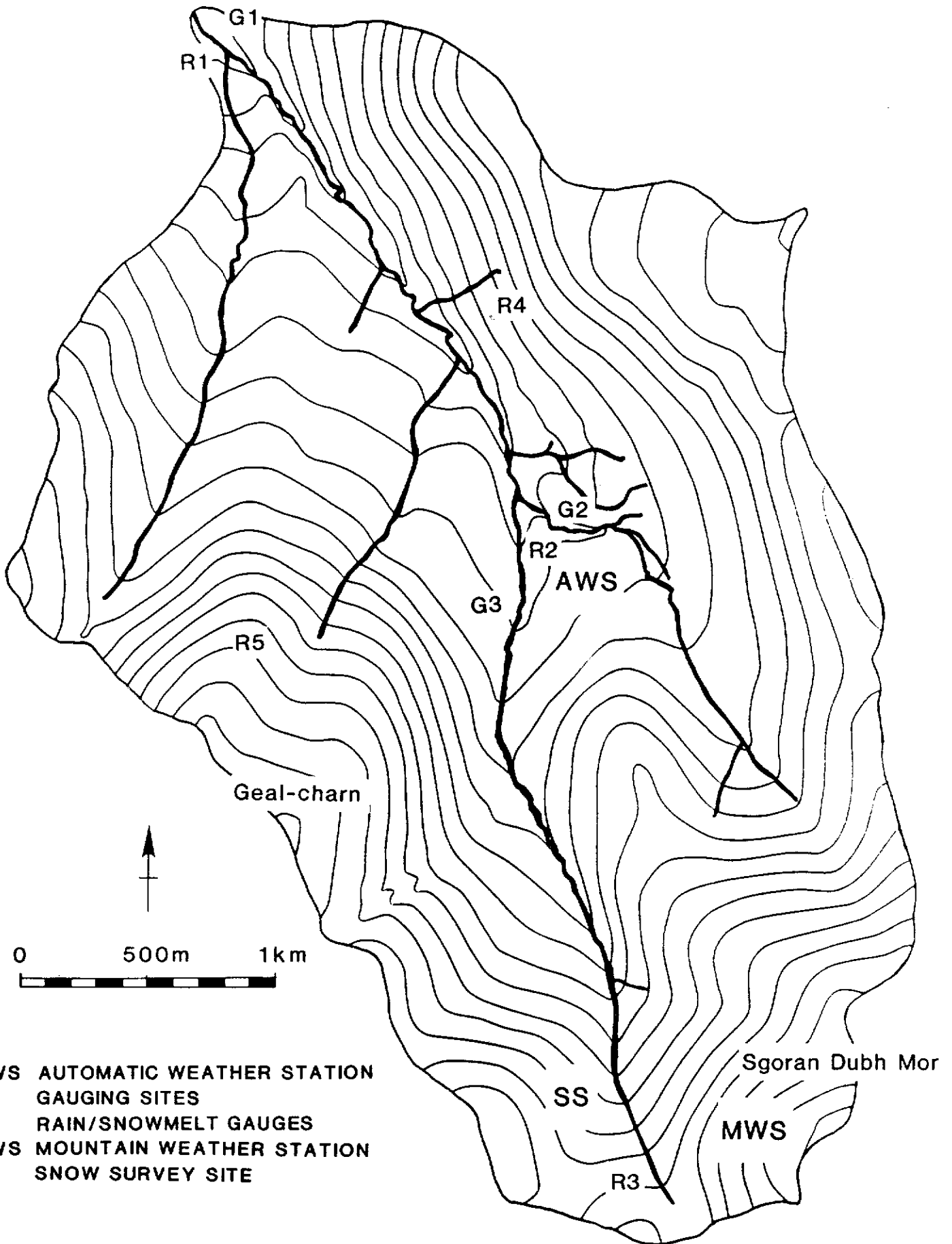
Appendix B shows the hourly rainfall intensities on a monthly basis at sites 1-5 and the average precipitation for the 5 gauges. Monthly

rainfall totals are given in figure 4 except for the winter when the raingauges were frozen and most/all precipitation fell as snow.

(4) METEOROLOGICAL DATA

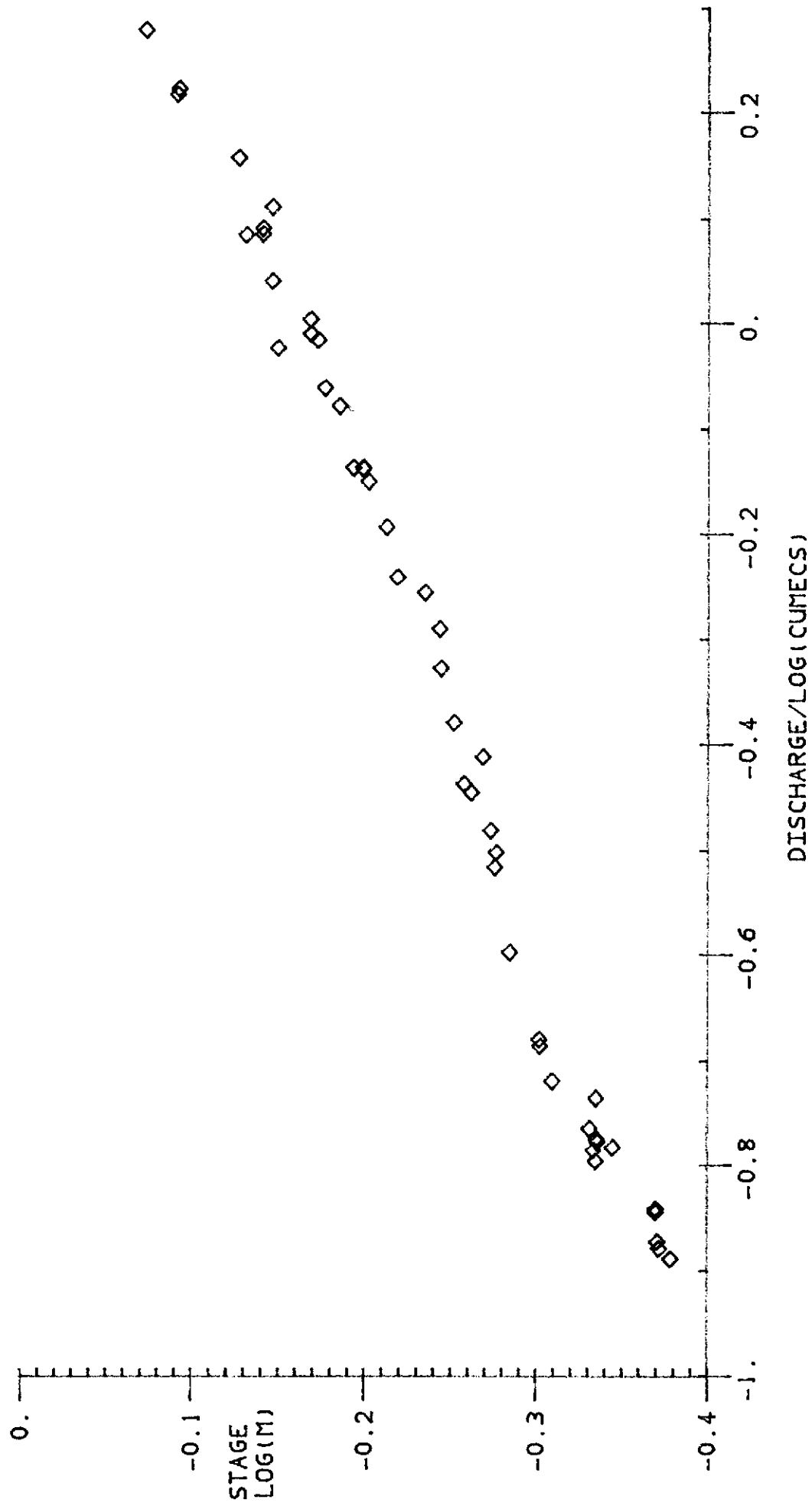
Meteorological data is collected at 5 minute intervals from two automatic weather stations as shown in figure 1. The five minute data is plotted as hourly averages/totals in Appendix C. The automatic weather station (AWS on figure 1) monitors wind run and direction, incoming and net radiation, wet and dry bulb temperature and rainfall. The mountain weather station (MWS on figure 1) monitors humidity, incoming and reflected radiation, temperature, wind run and direction. Results from the MWS are being processed and error checked and so are not yet available.

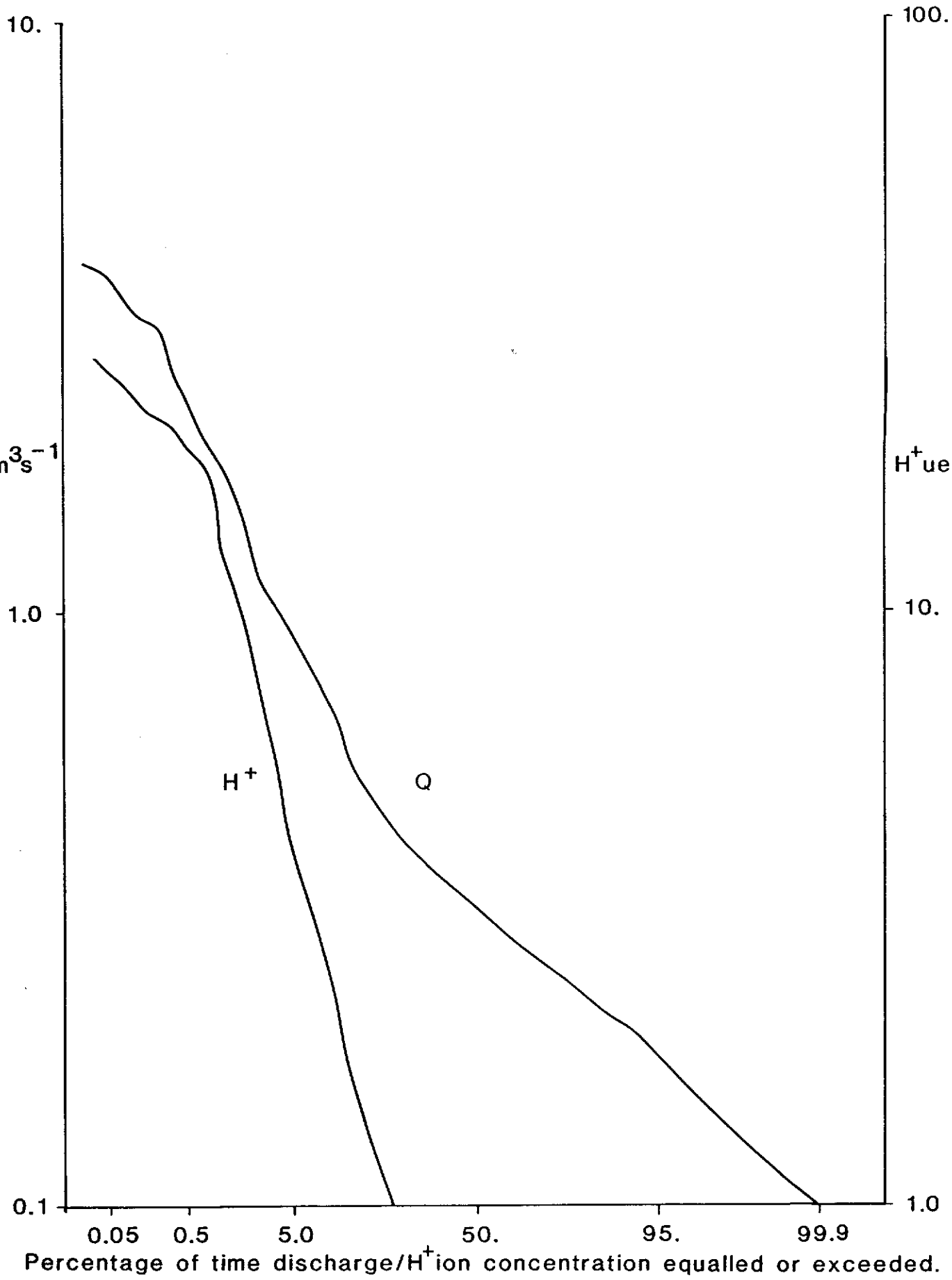
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- AWS AUTOMATIC WEATHER STATION
- G GAUGING SITES
- R RAIN/SNOWMELT GAUGES
- MWS MOUNTAIN WEATHER STATION
- SS SNOW SURVEY SITE

STAGE-DISCHARGE RATING CURVE

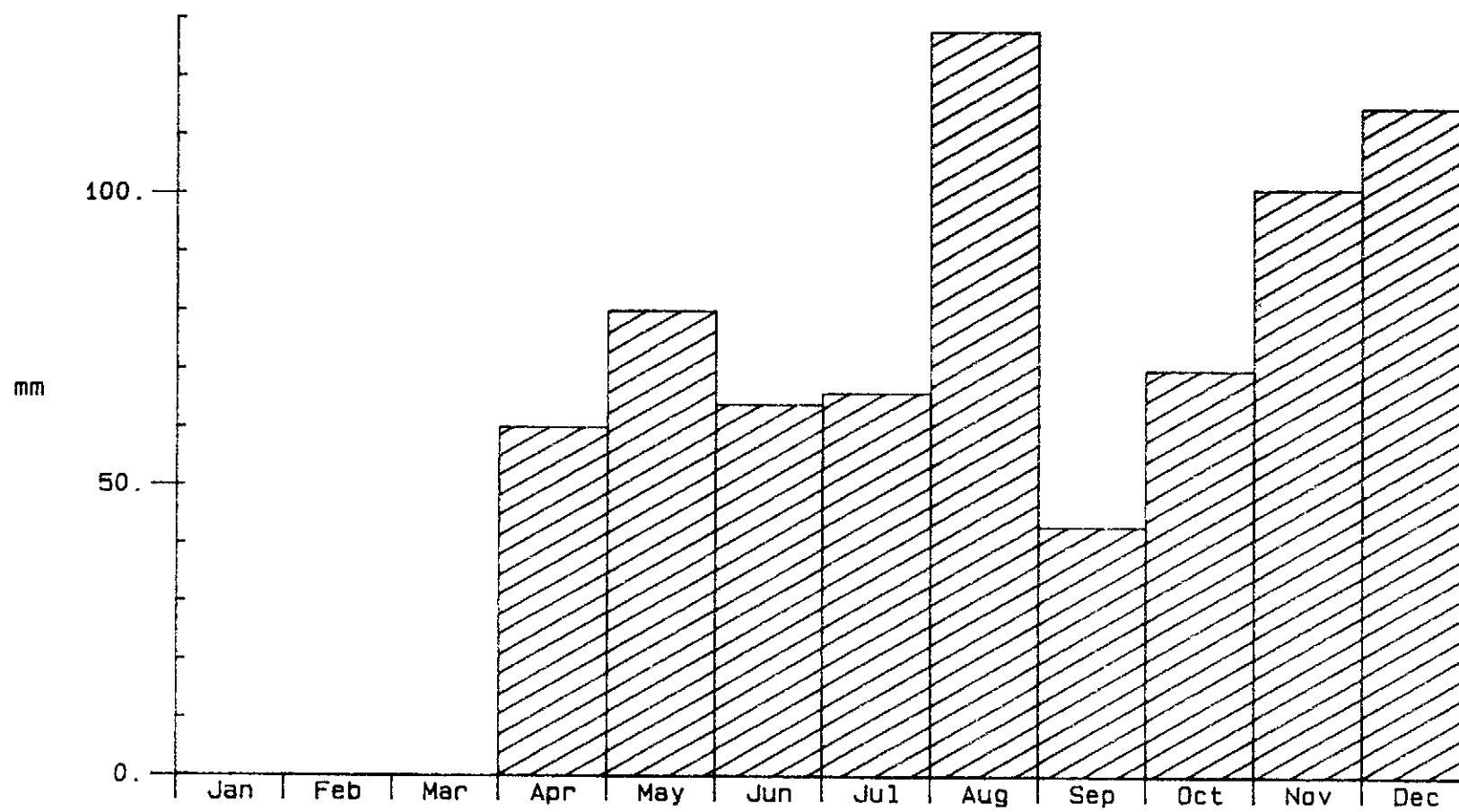


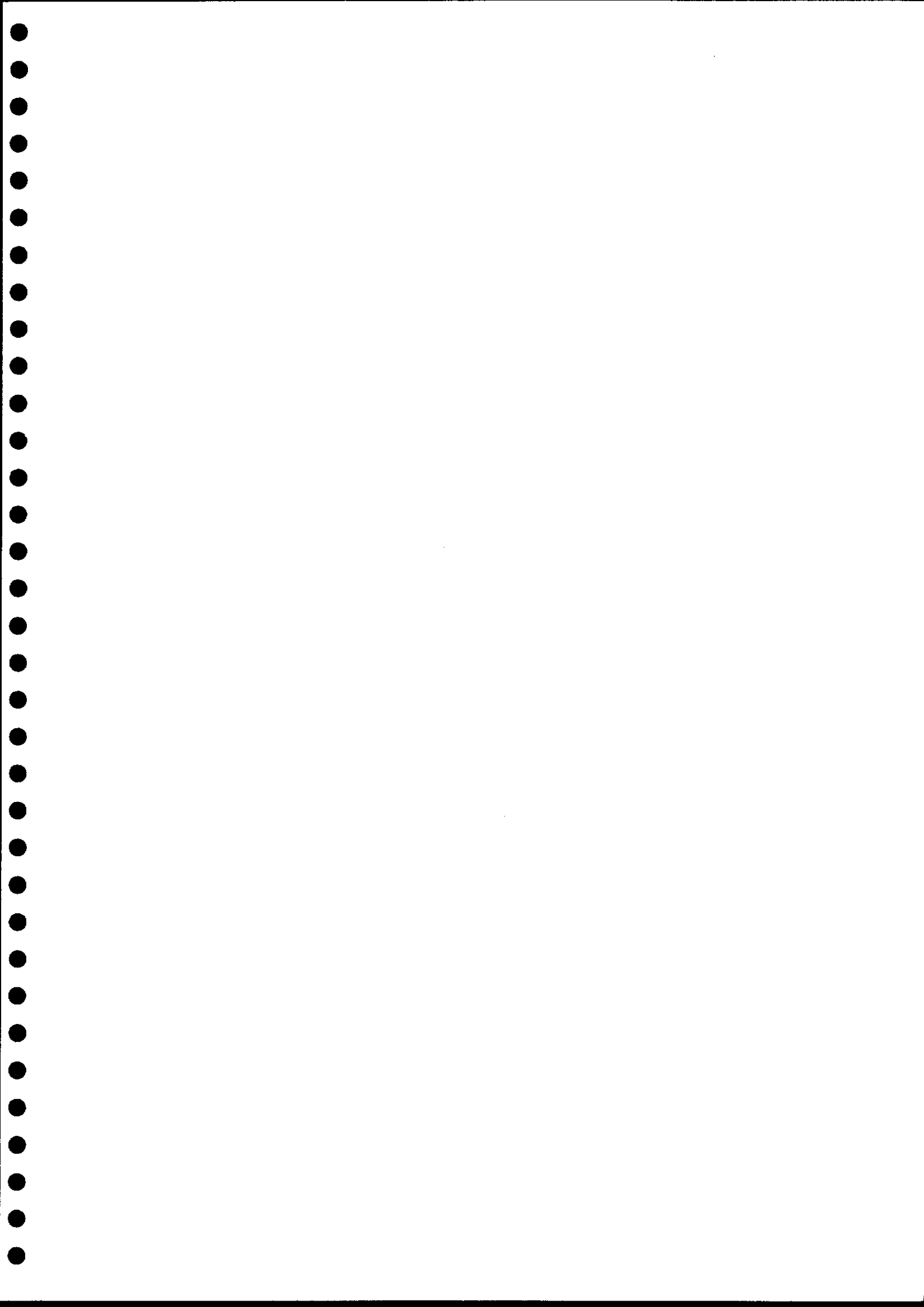


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MONTHLY PRECIPITATION

1986



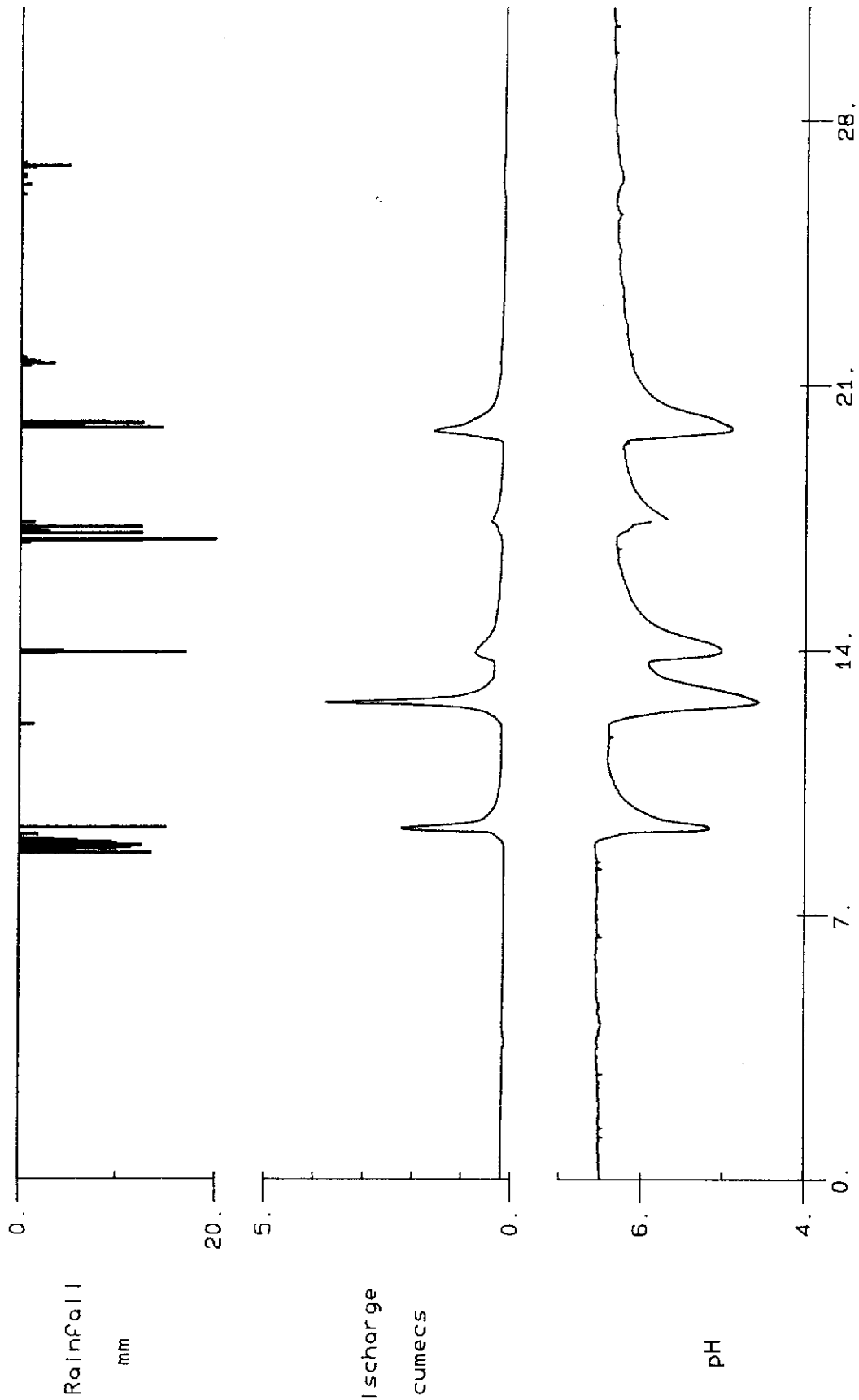


Appendix A

Monthly summaries of 20 minute instantaneous data from the
catchment outflow

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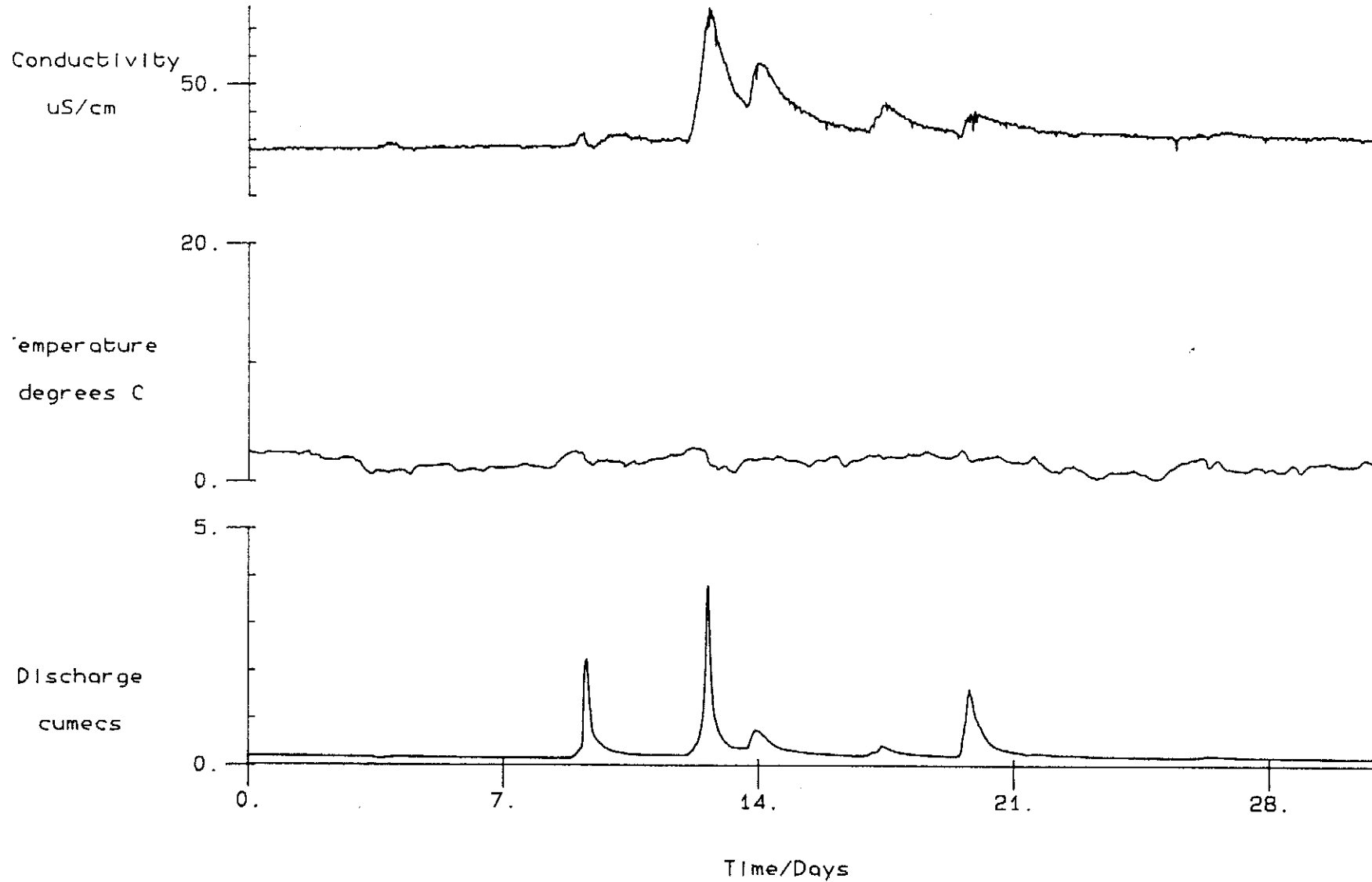
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Time/Days

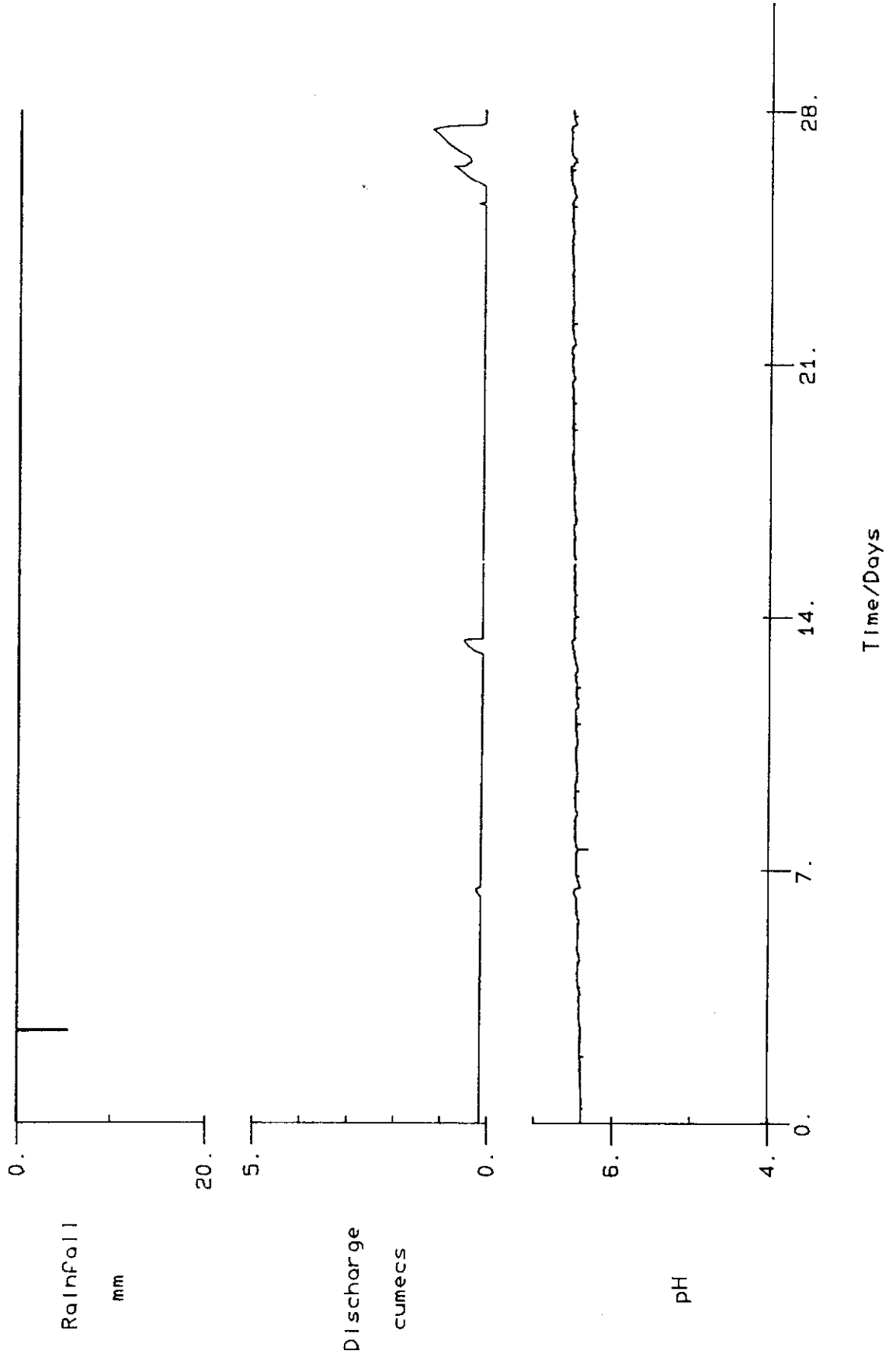
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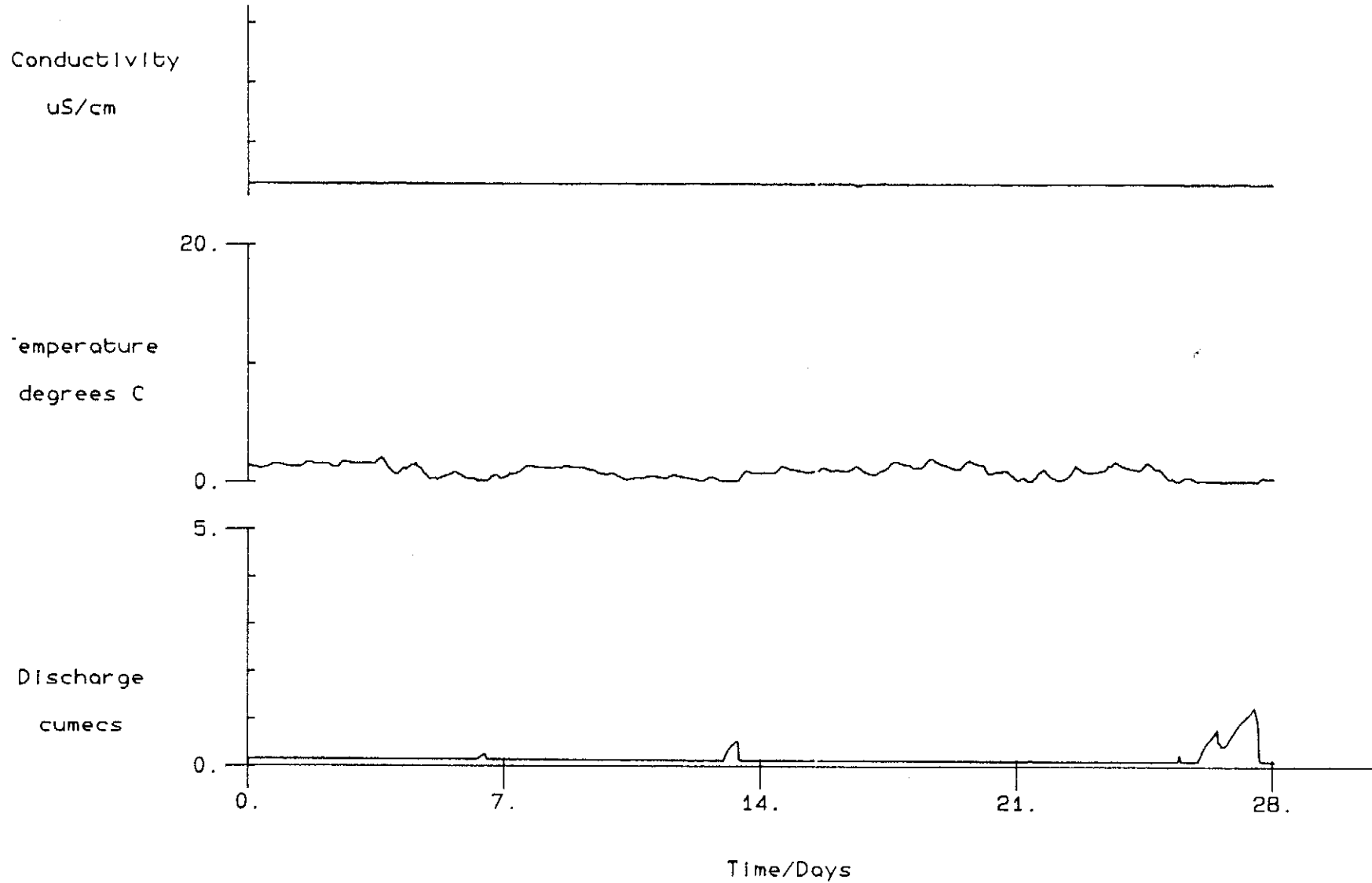


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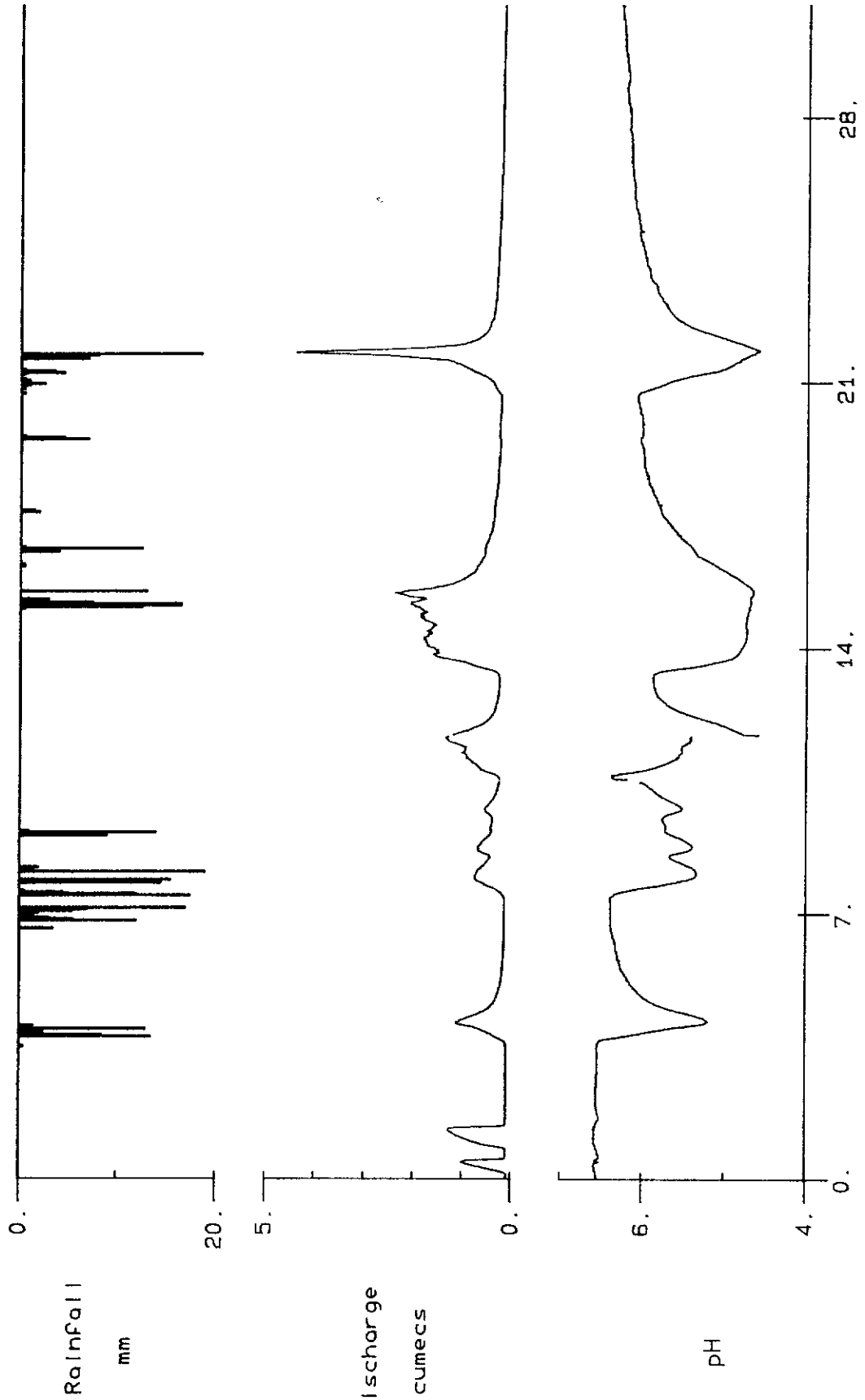


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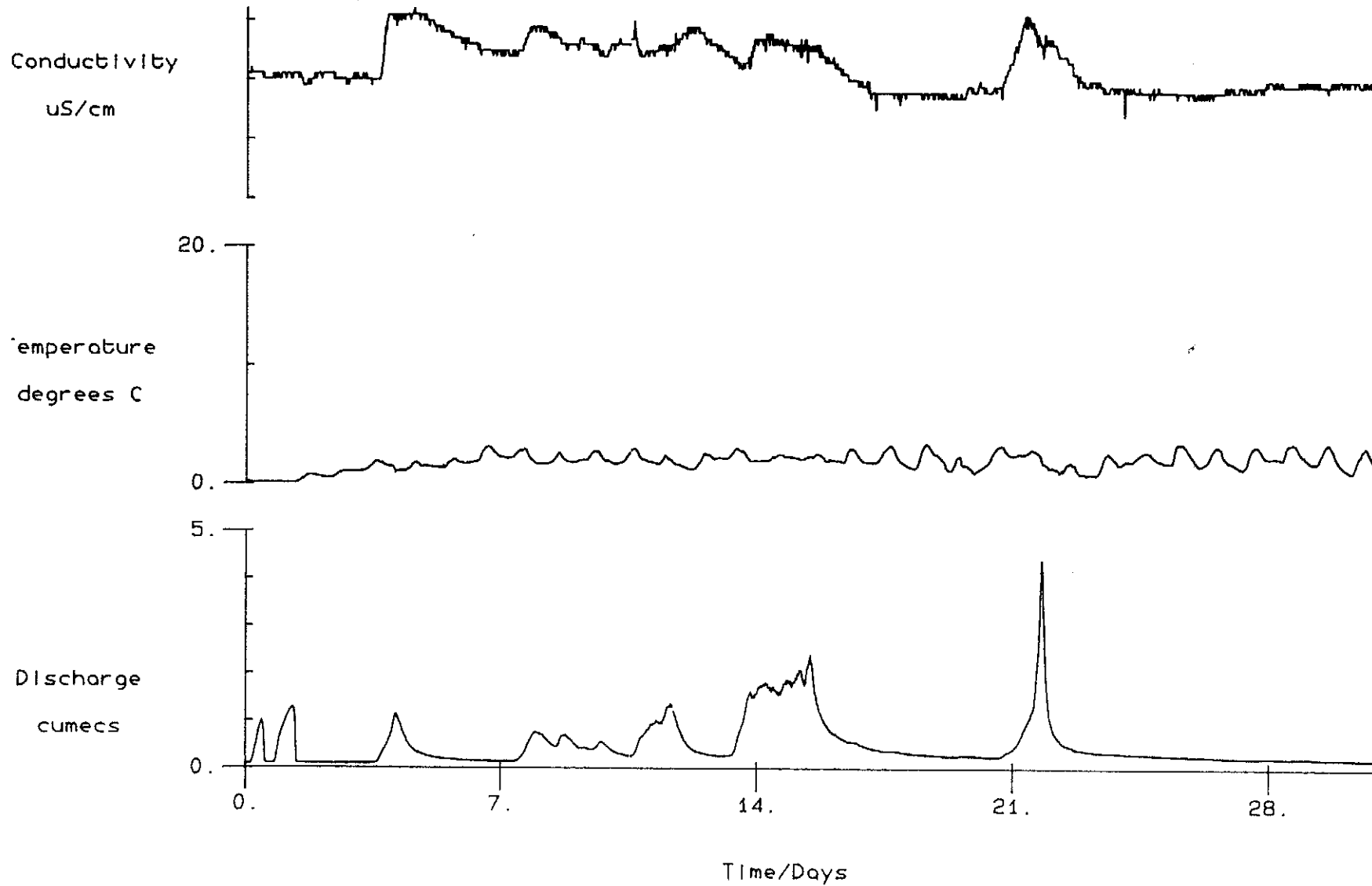
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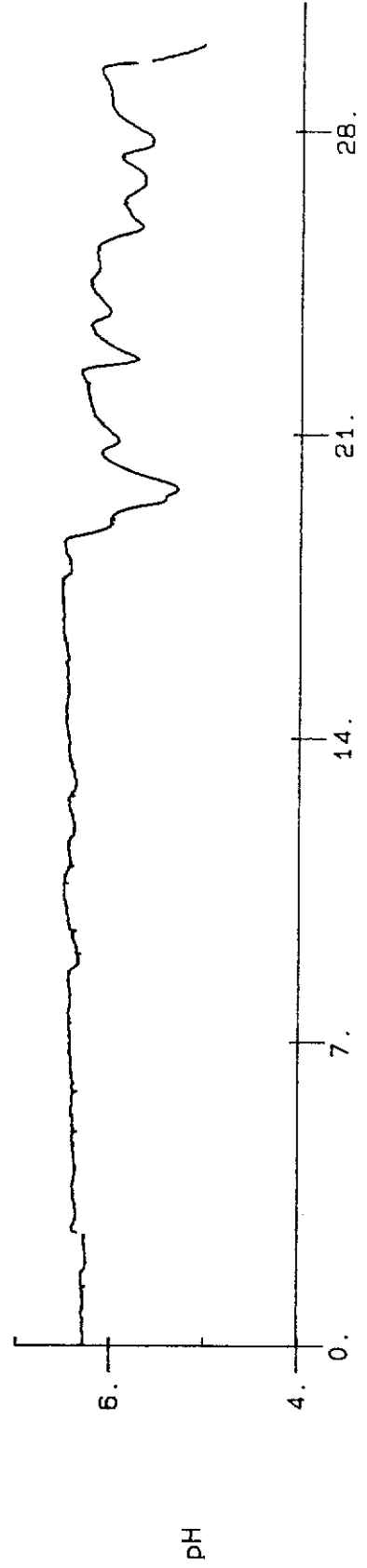
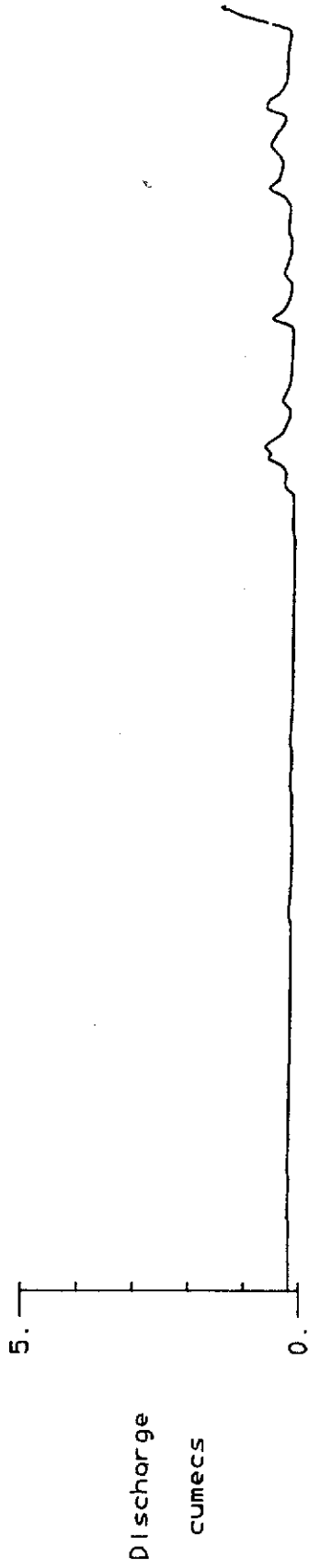
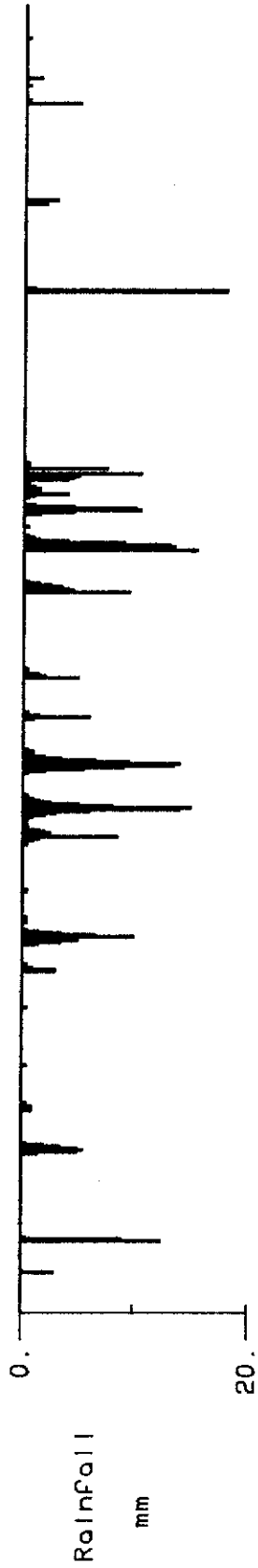


Time/Days

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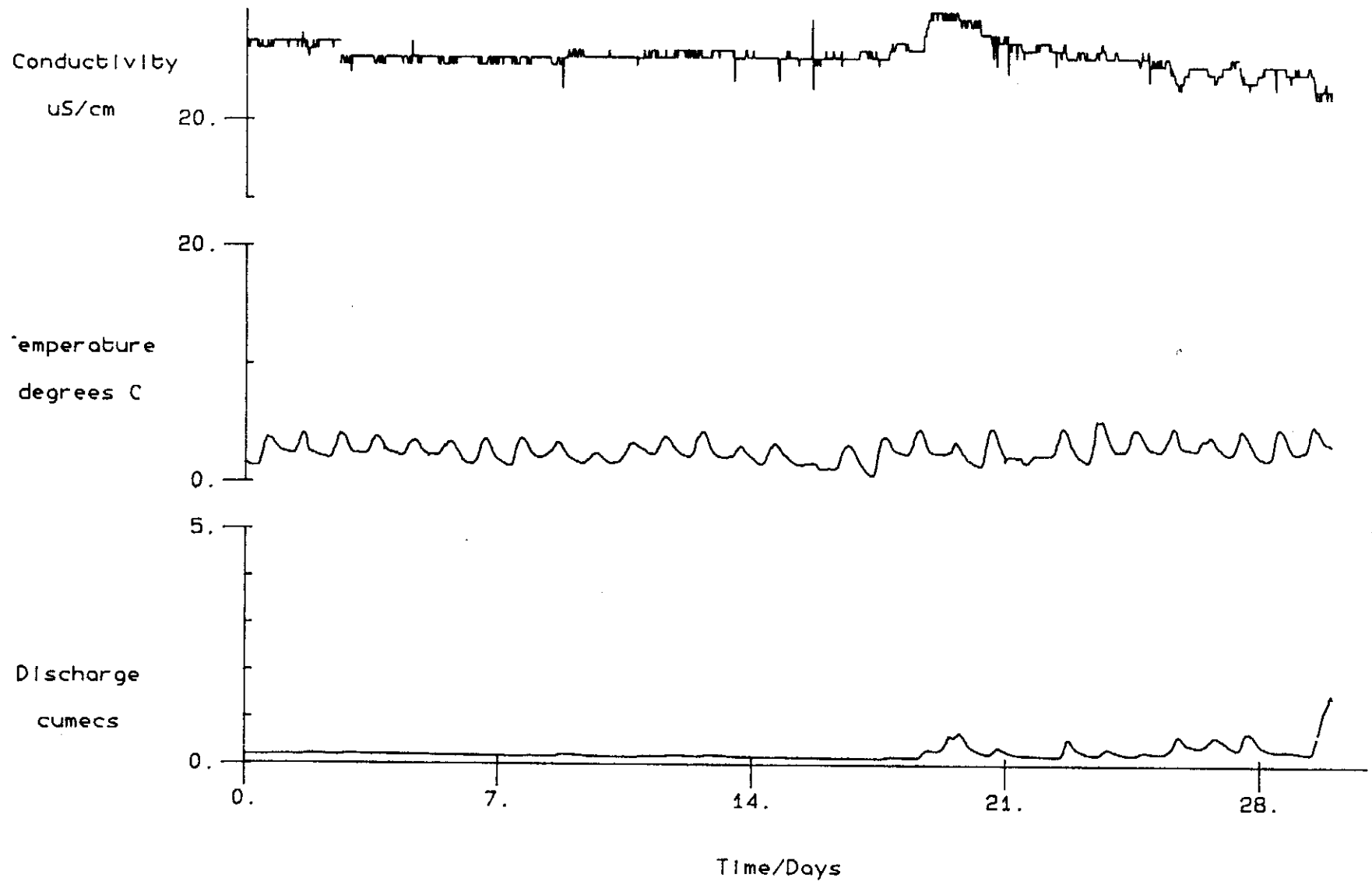
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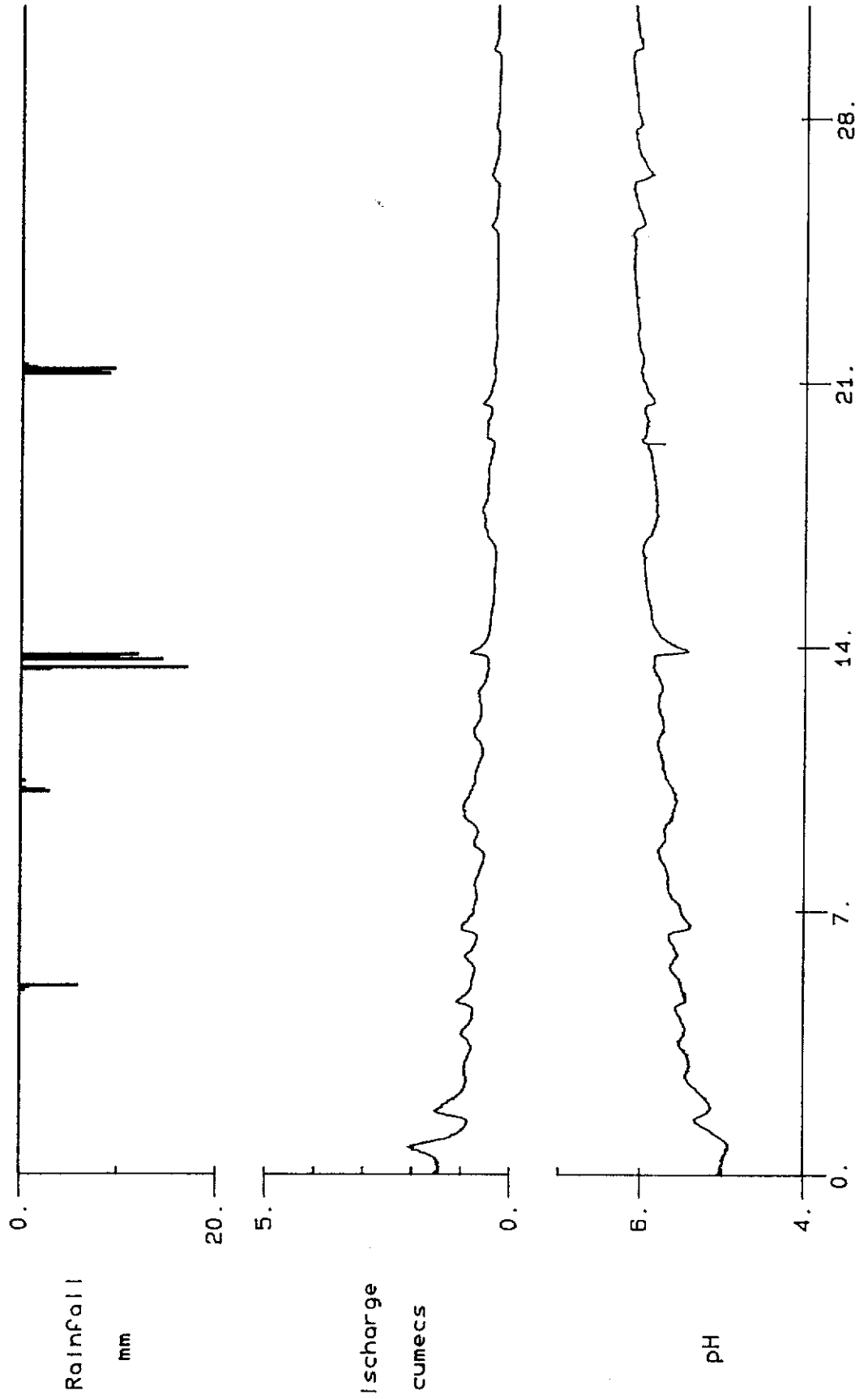
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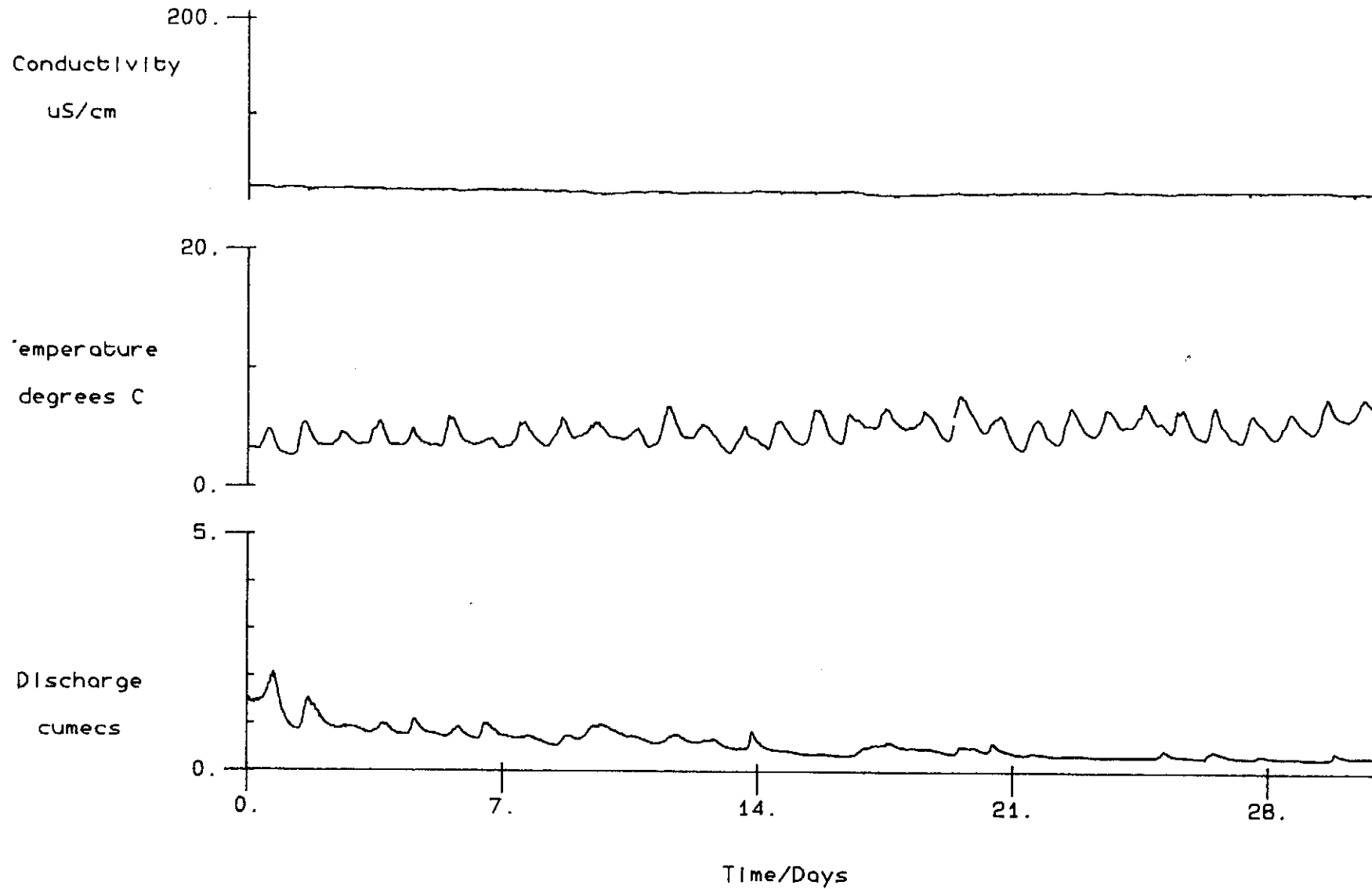
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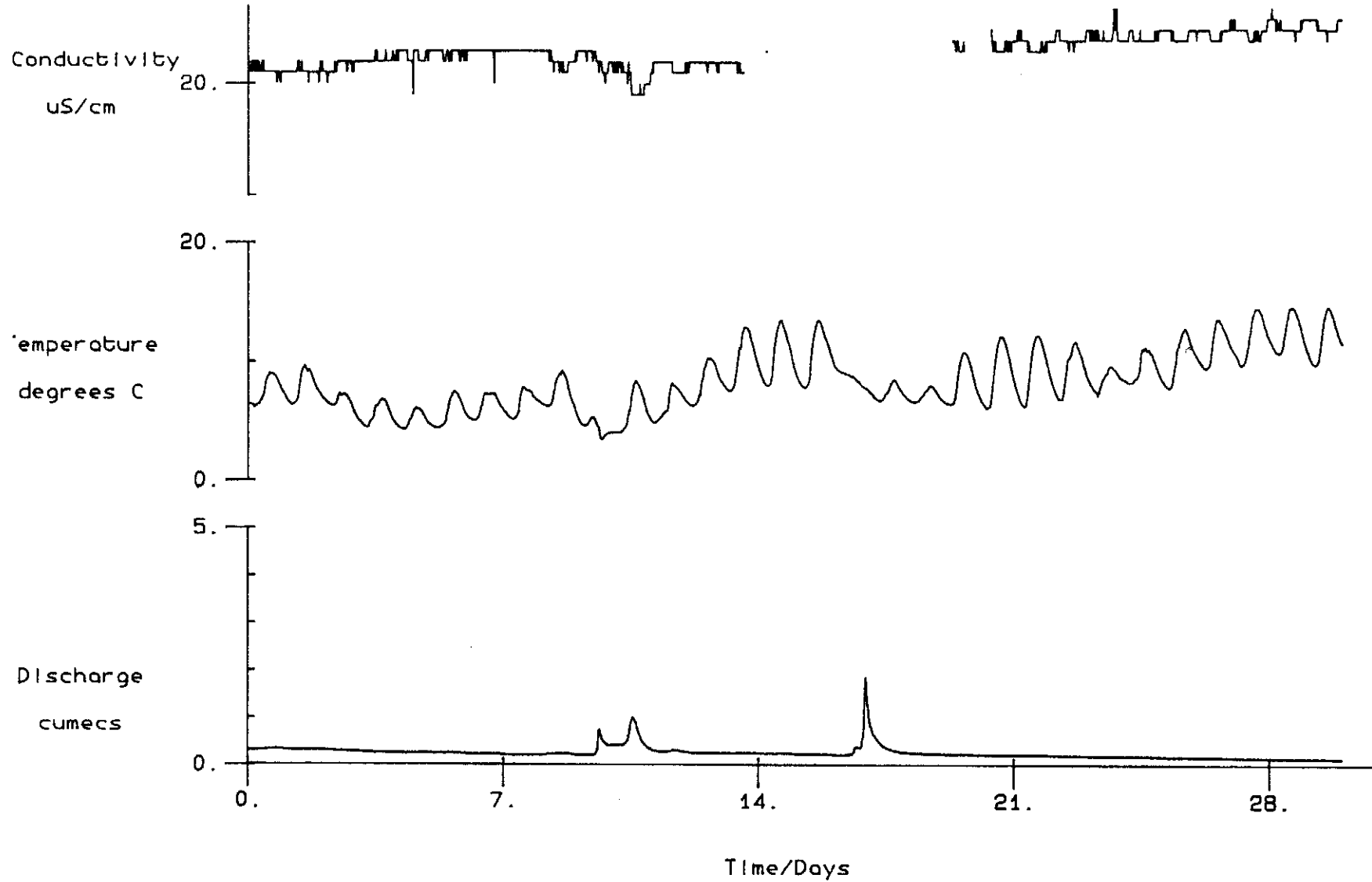
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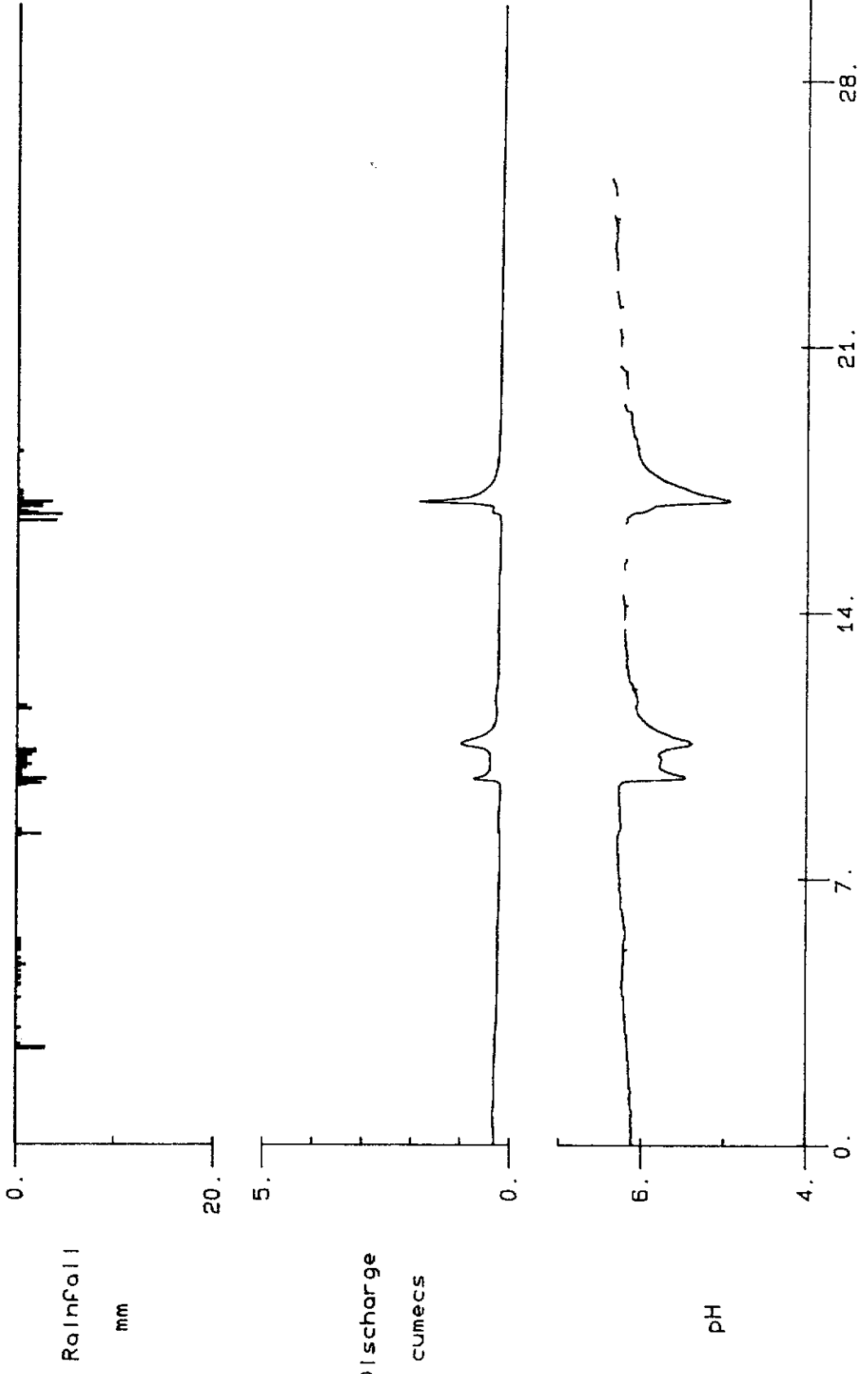
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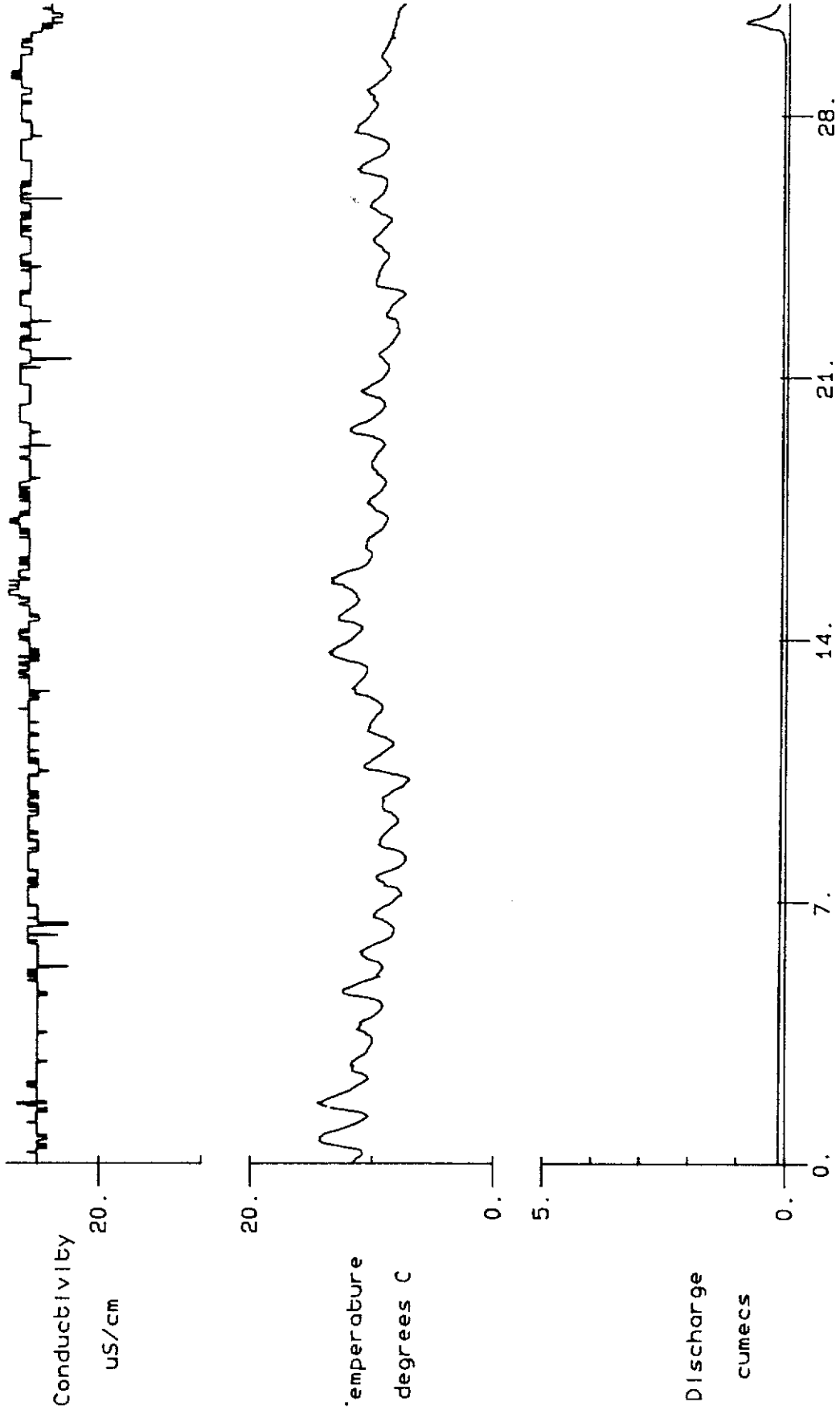
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Time/Days

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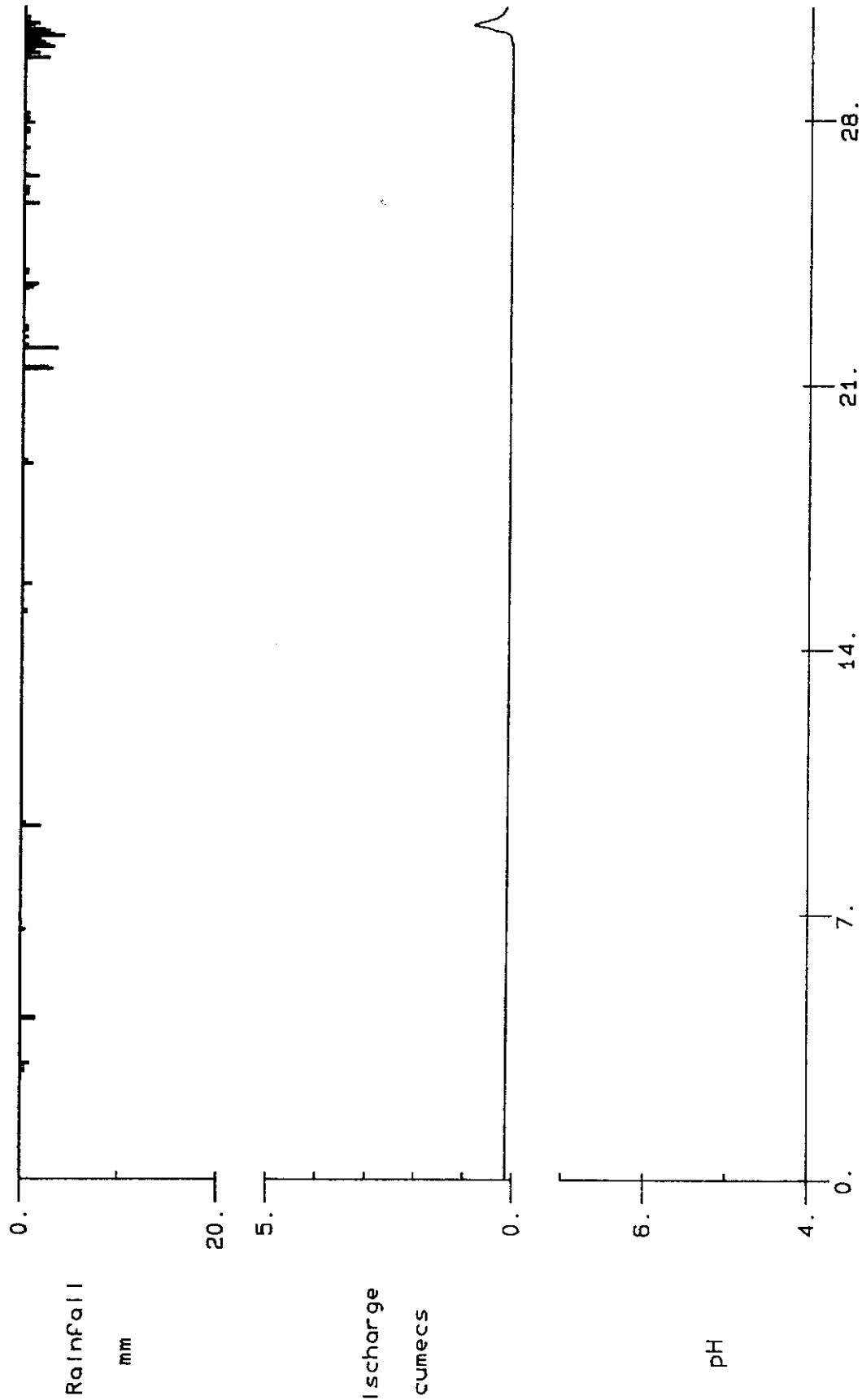
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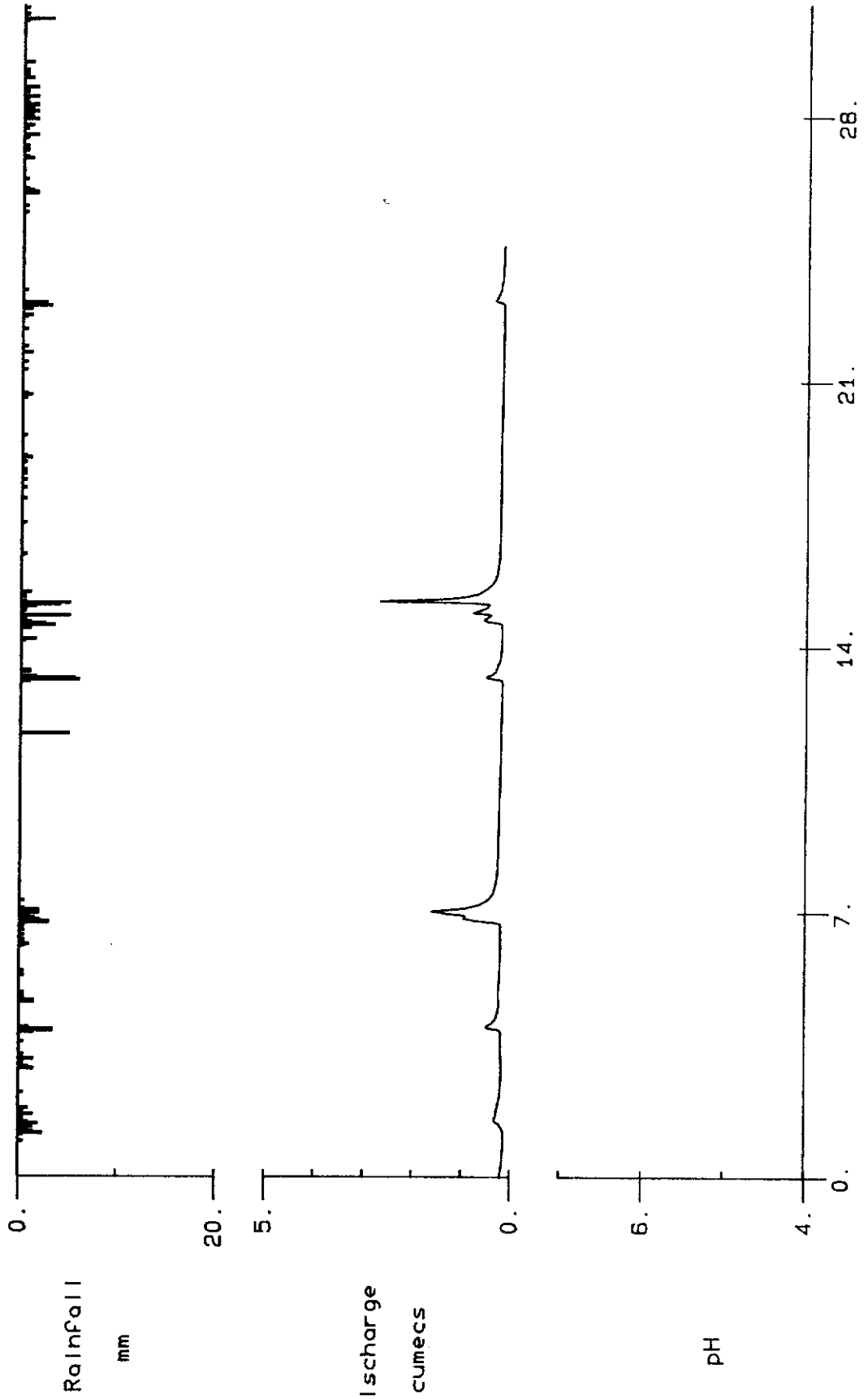
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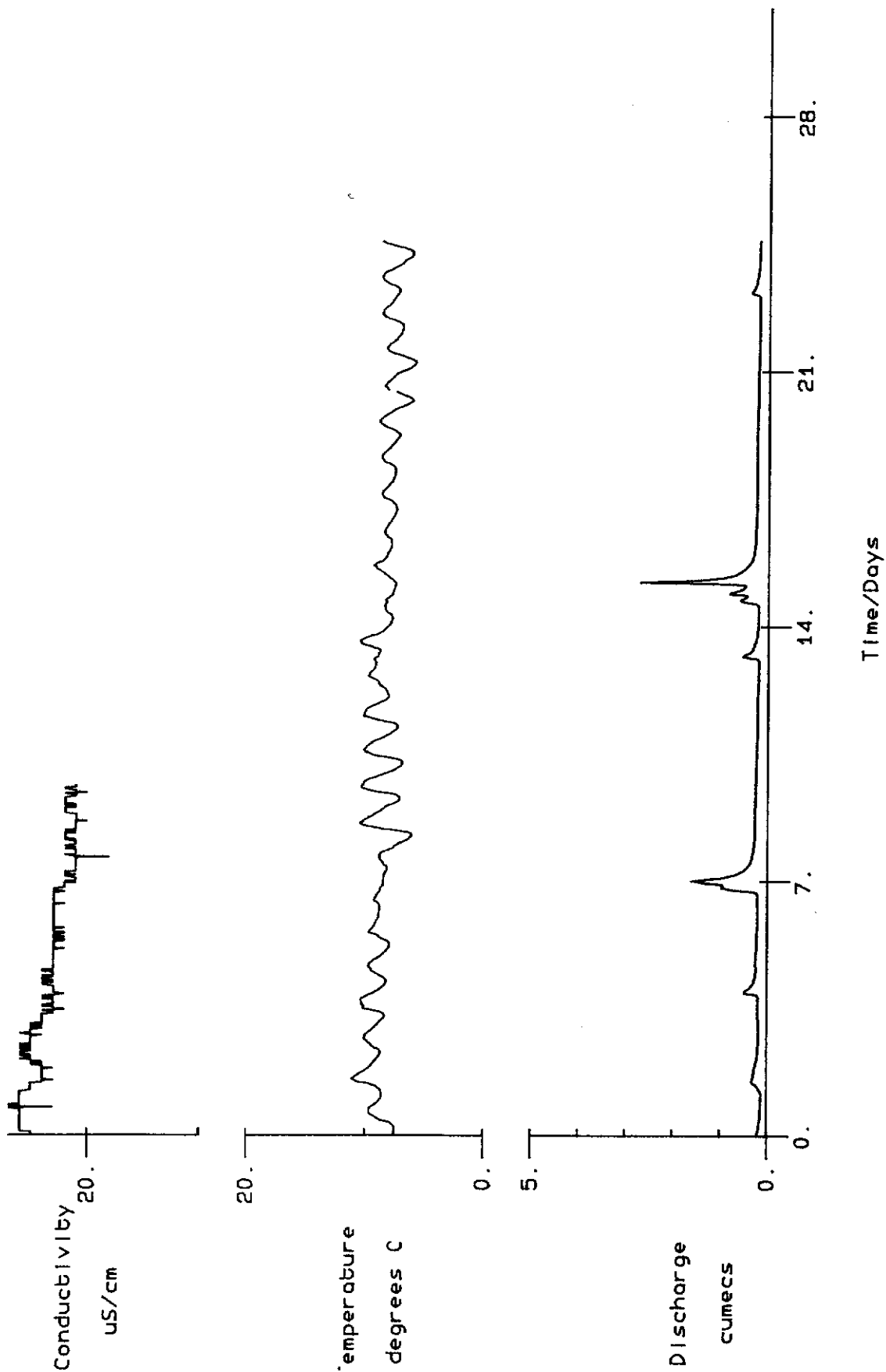
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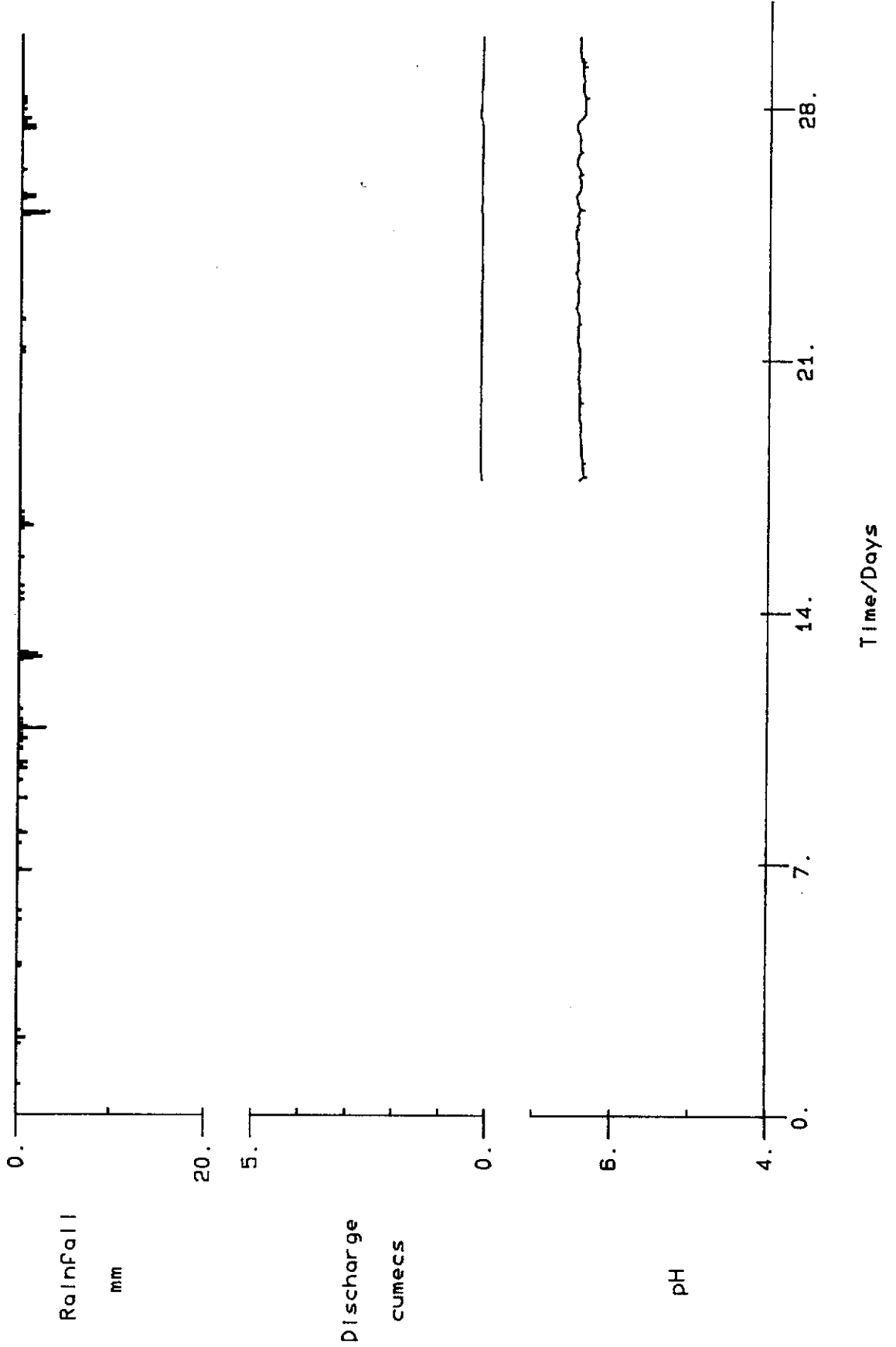
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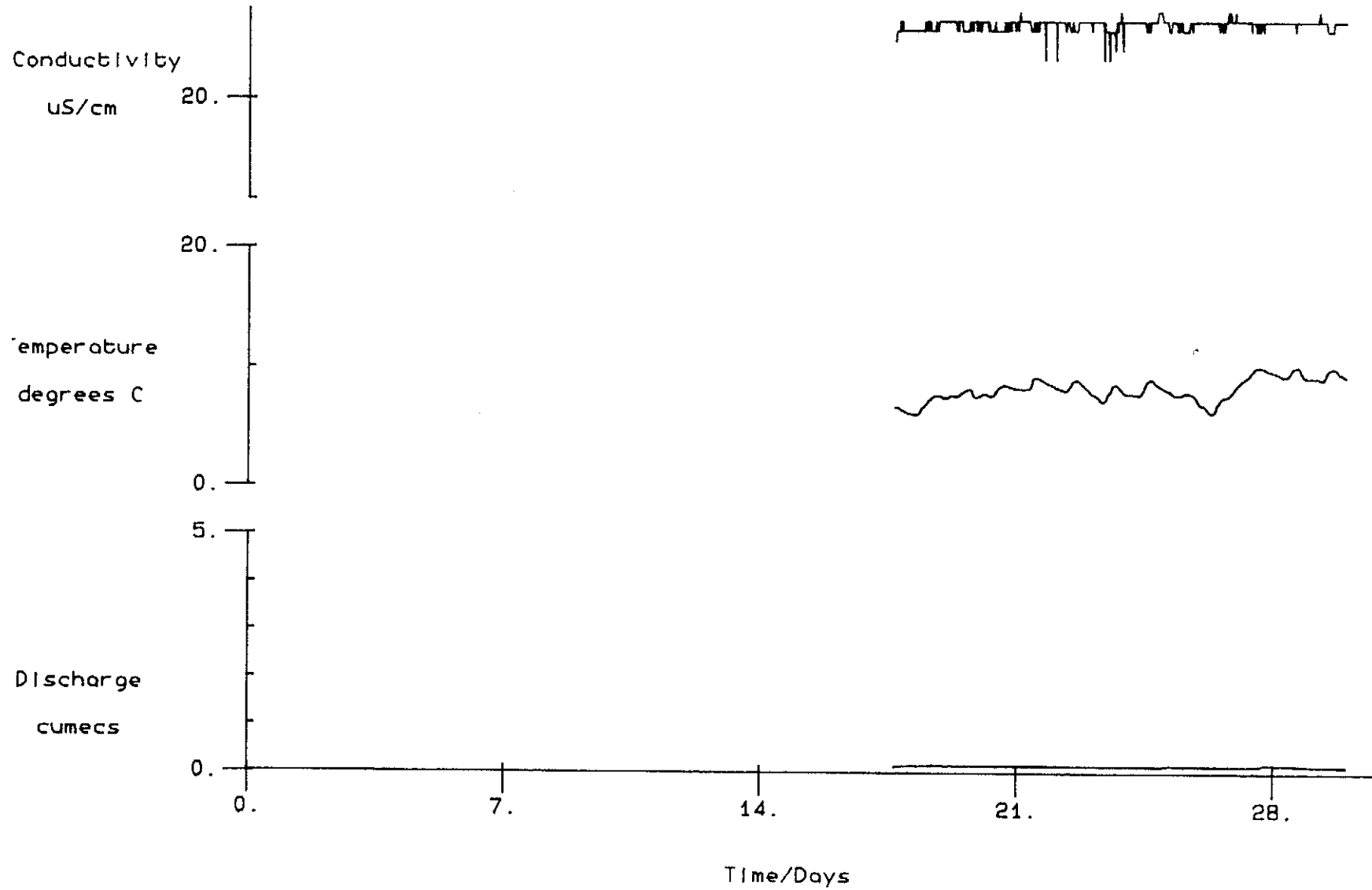


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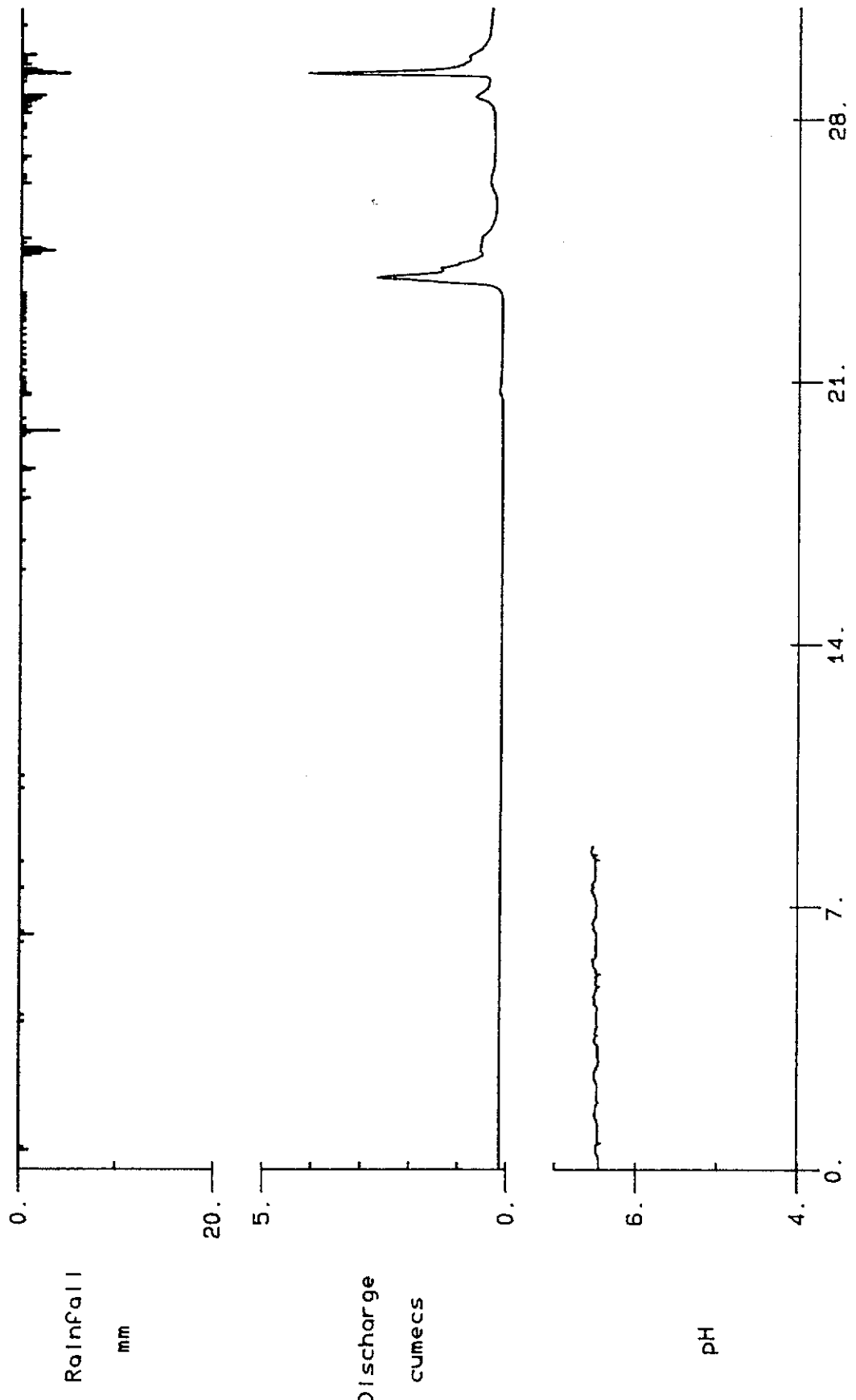


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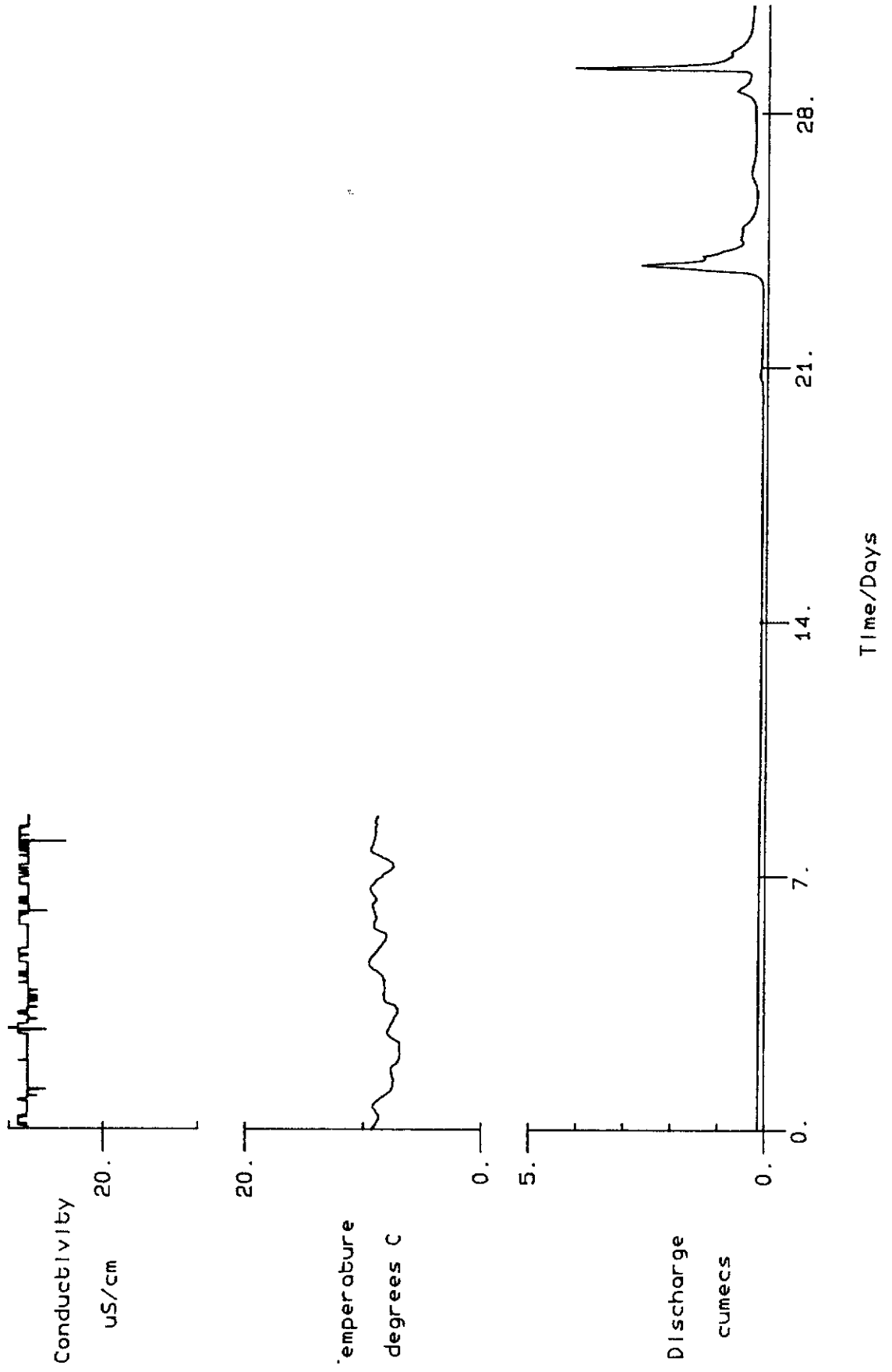


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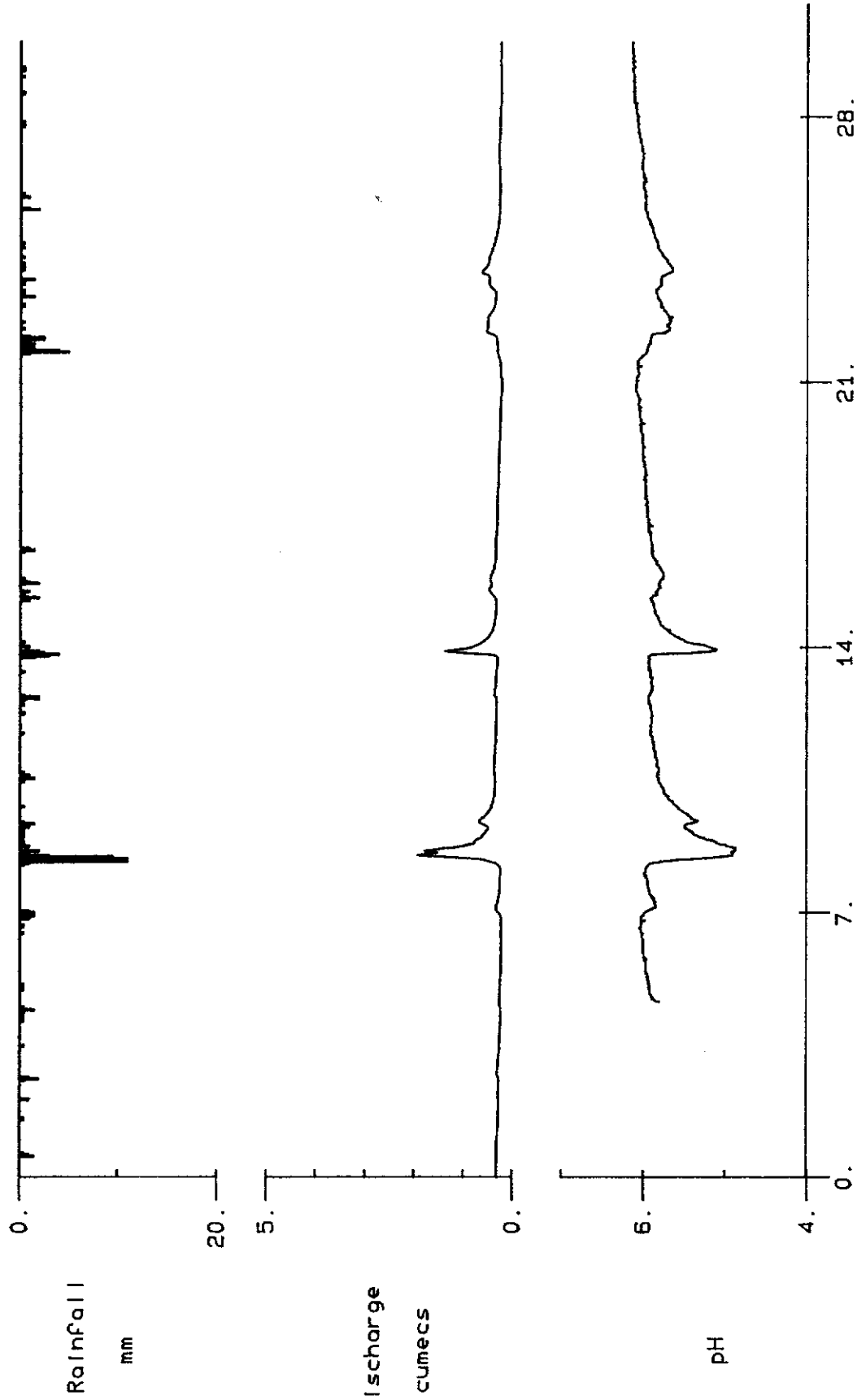


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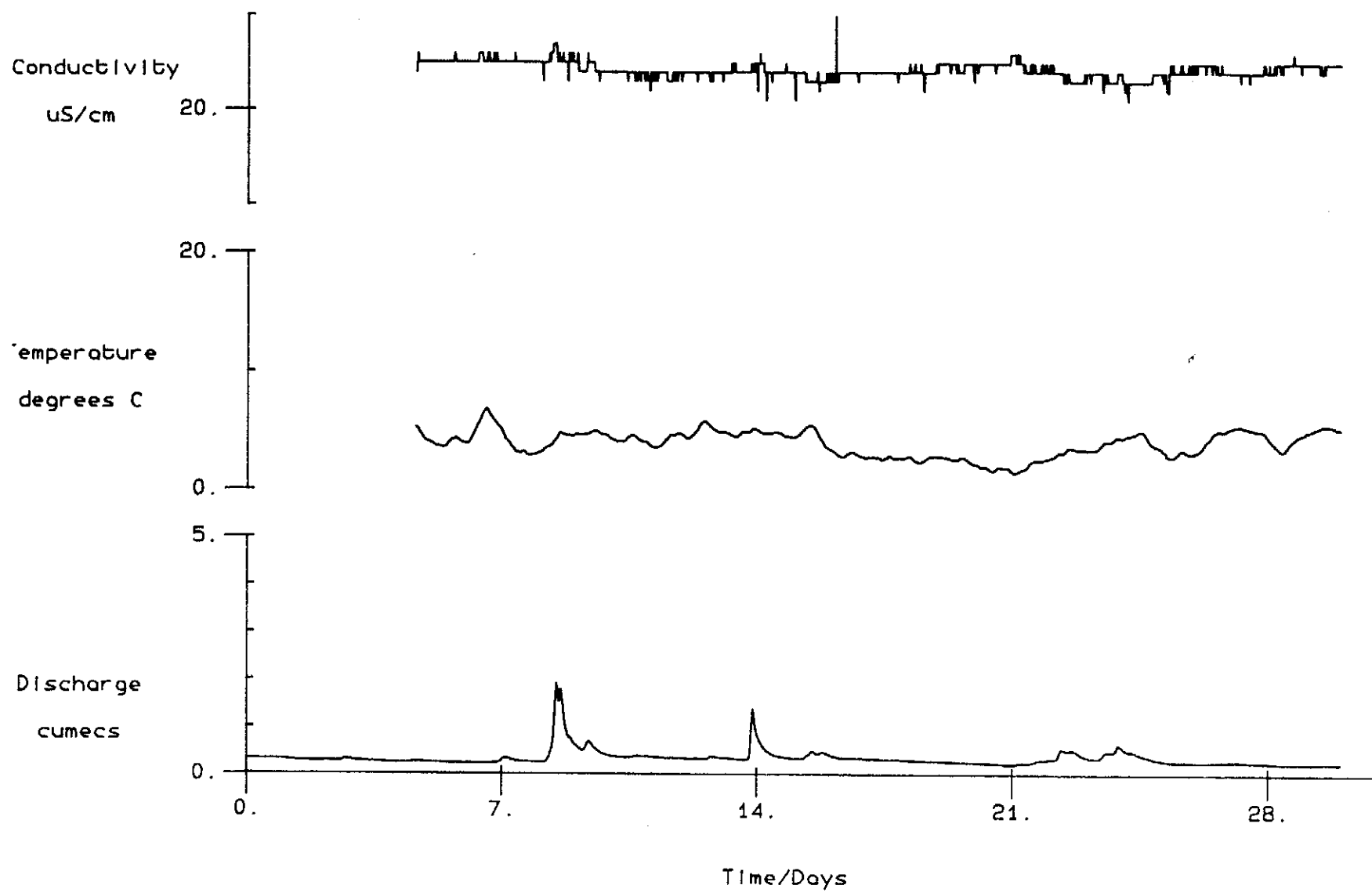
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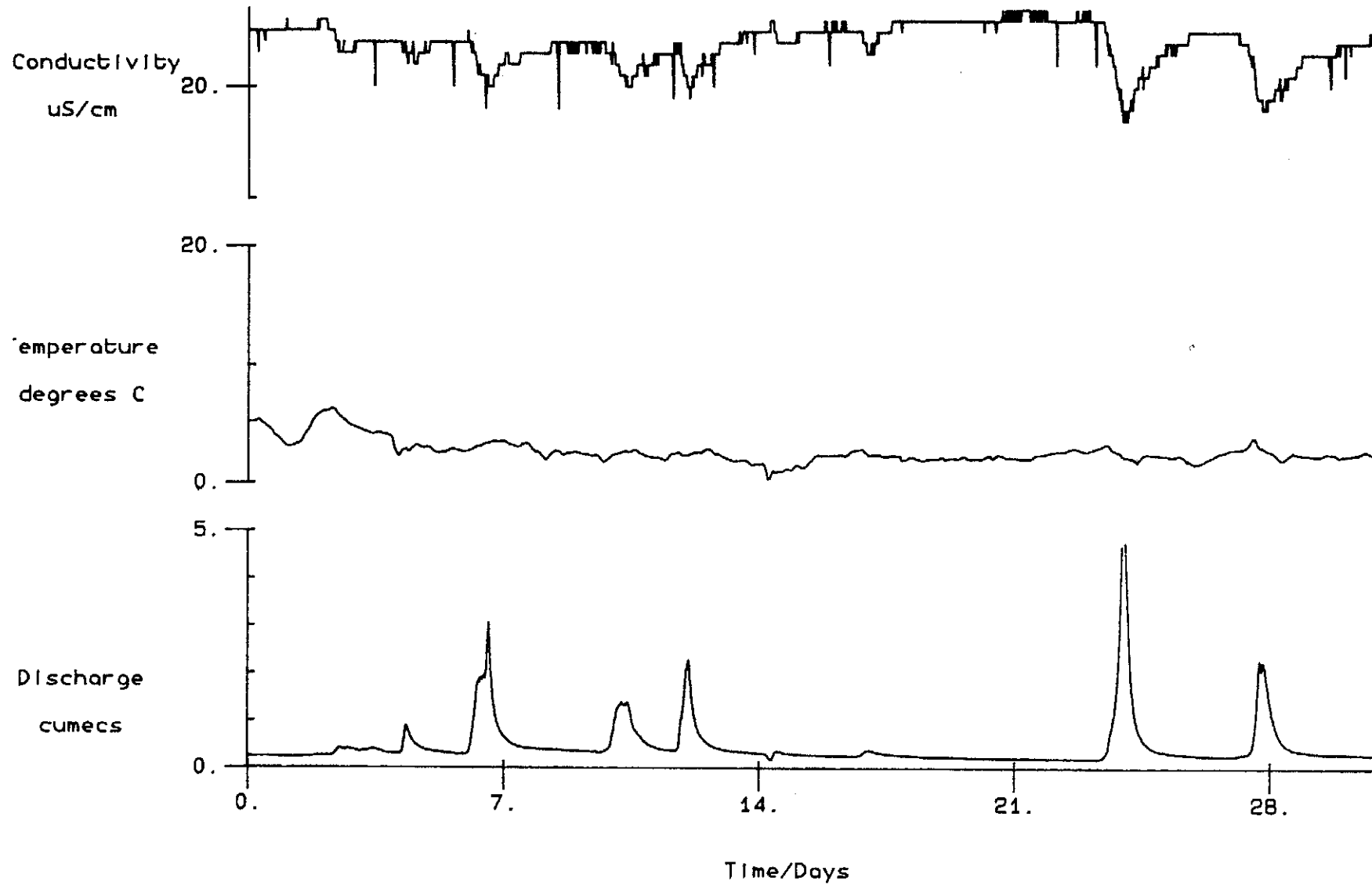
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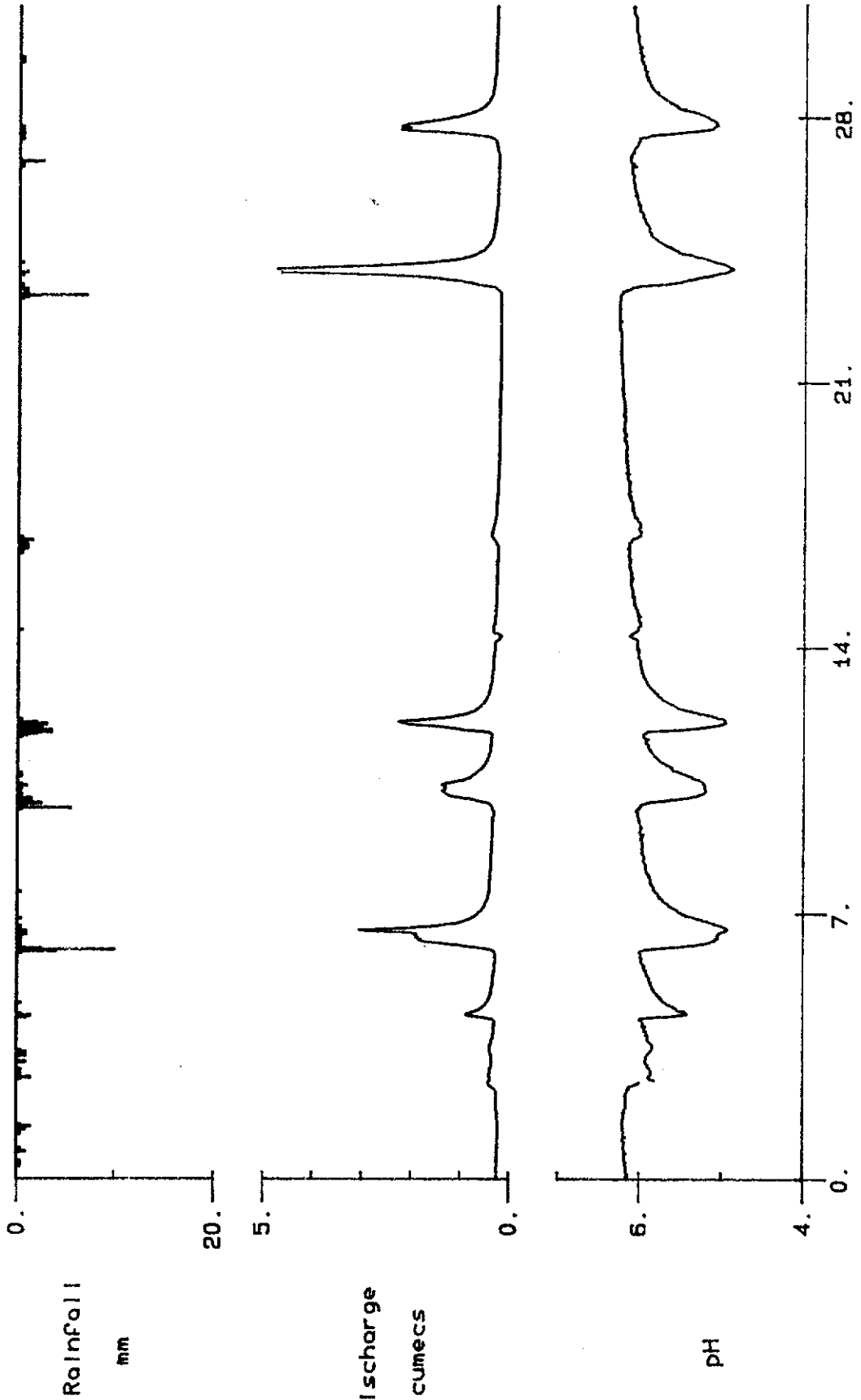


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Time/Days

Appendix B

Monthly summaries of hourly rainfall intensities from 5 raingauges and their arithmetic mean.

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GAUGE 2 = At meteorological site

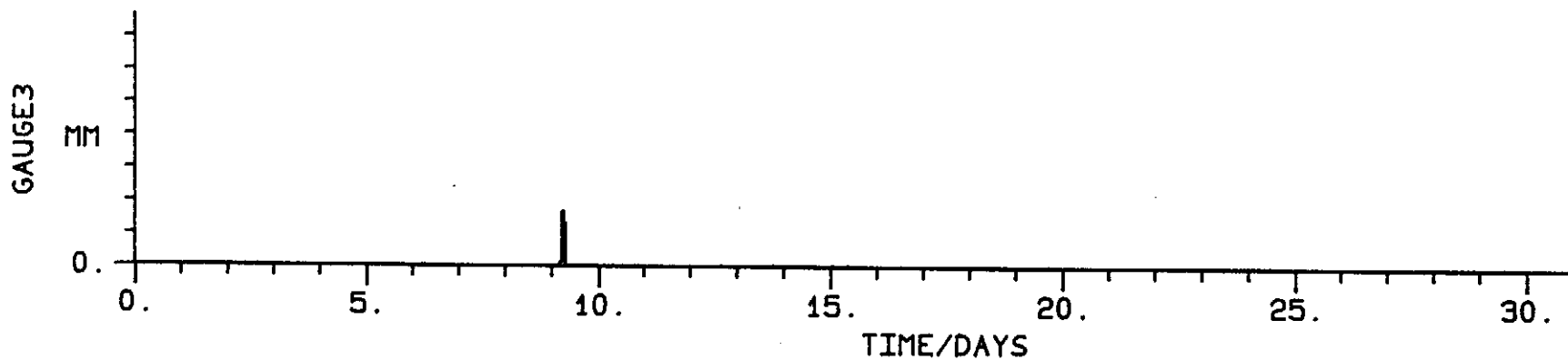
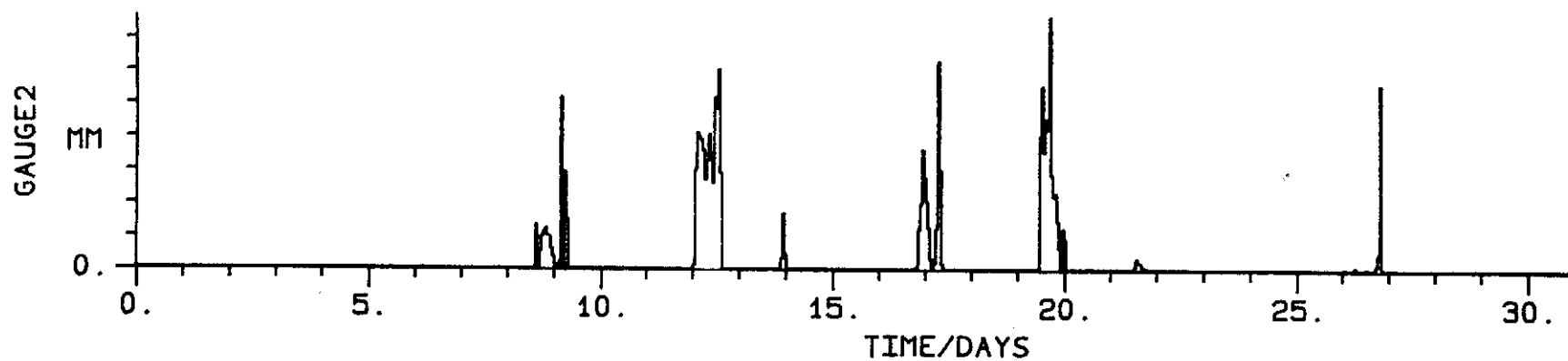
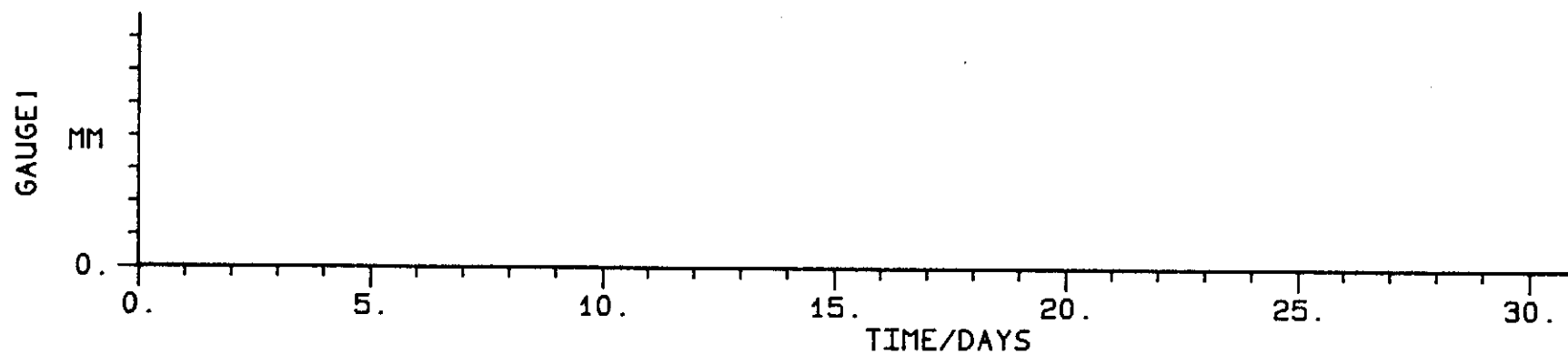
GAUGE 3 = On the col below Sgoran Dubh Mor.

GAUGE 4 = At Peaty Podsol site

GAUGE 5 = At Alpine Podsol site

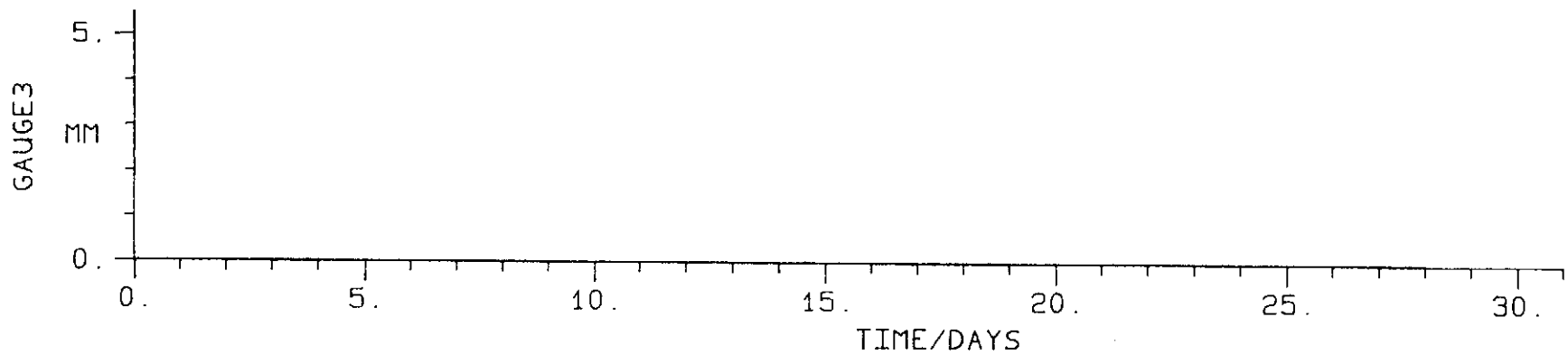
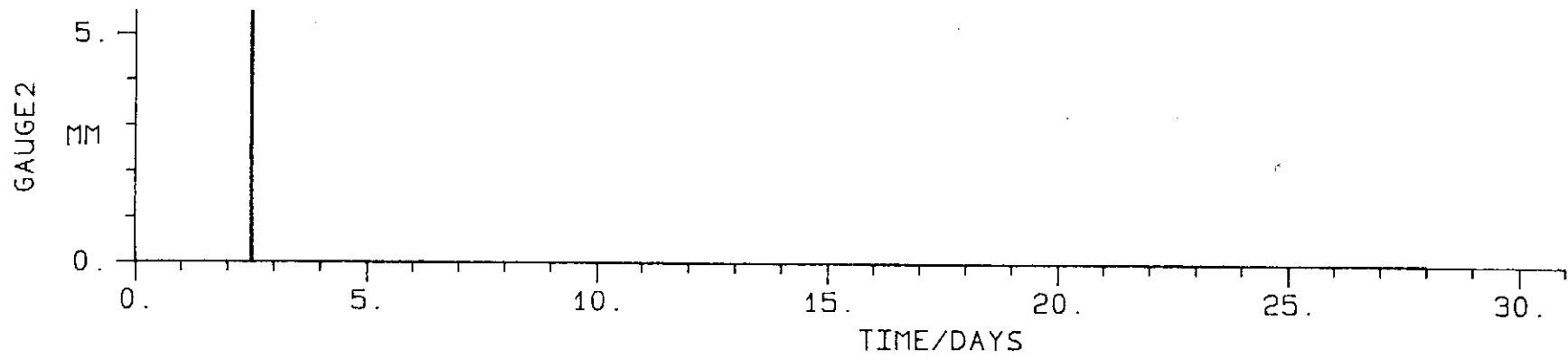
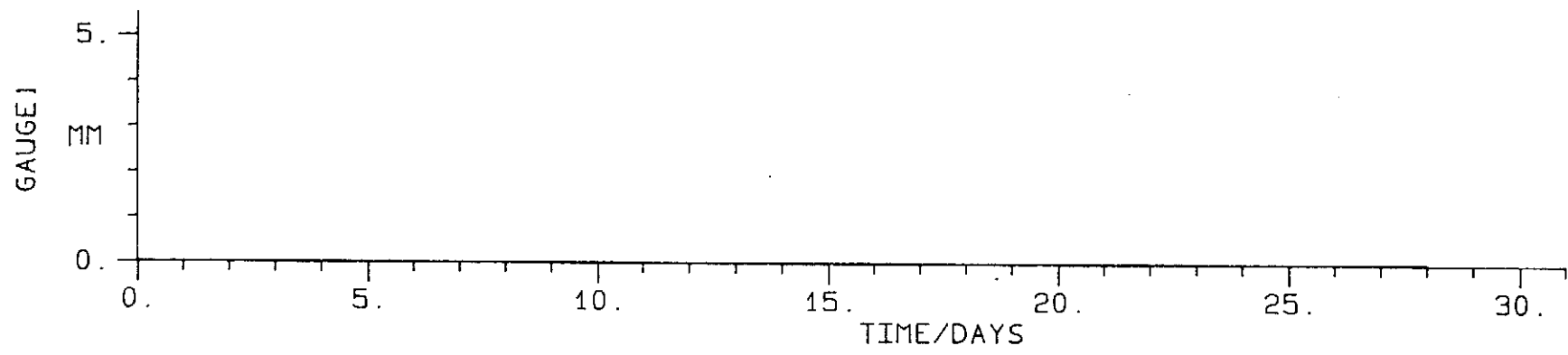
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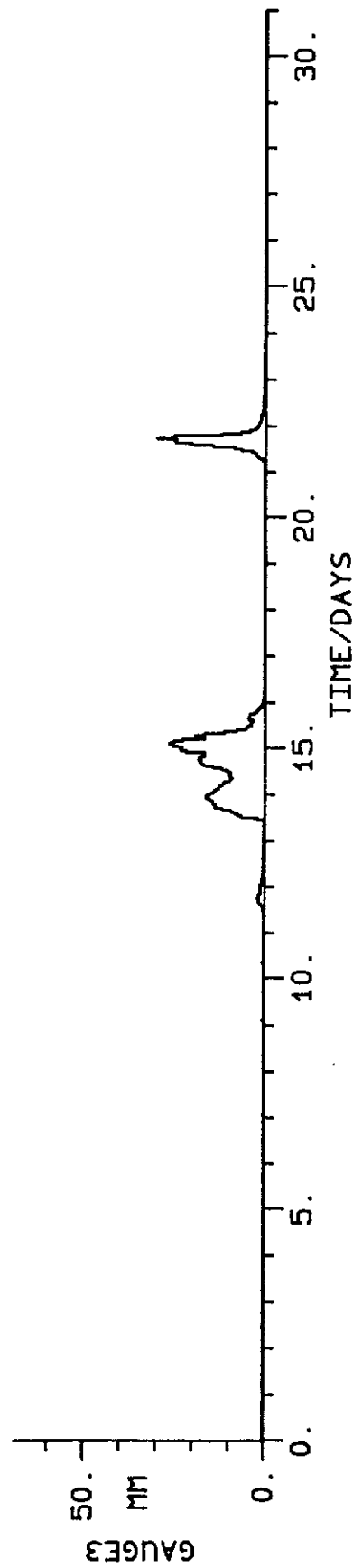
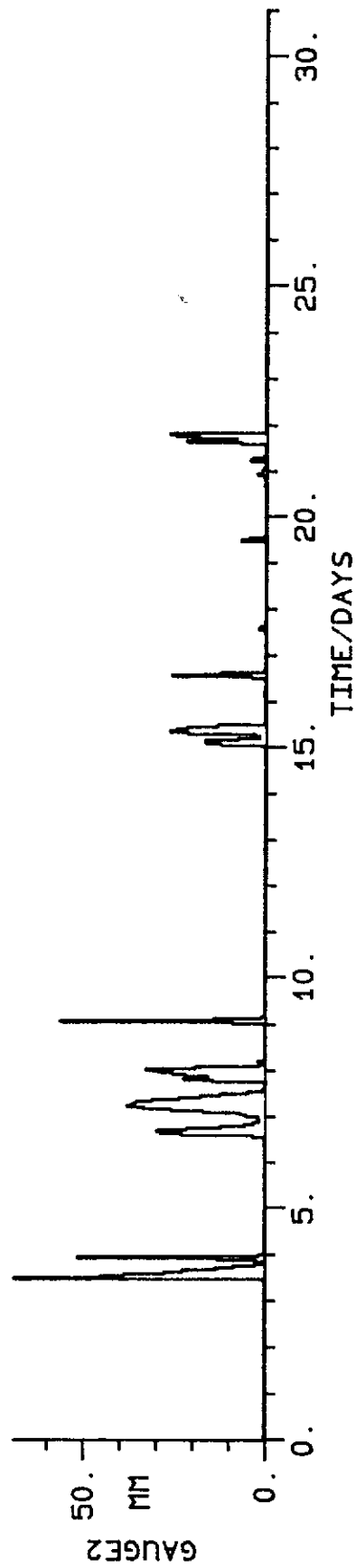
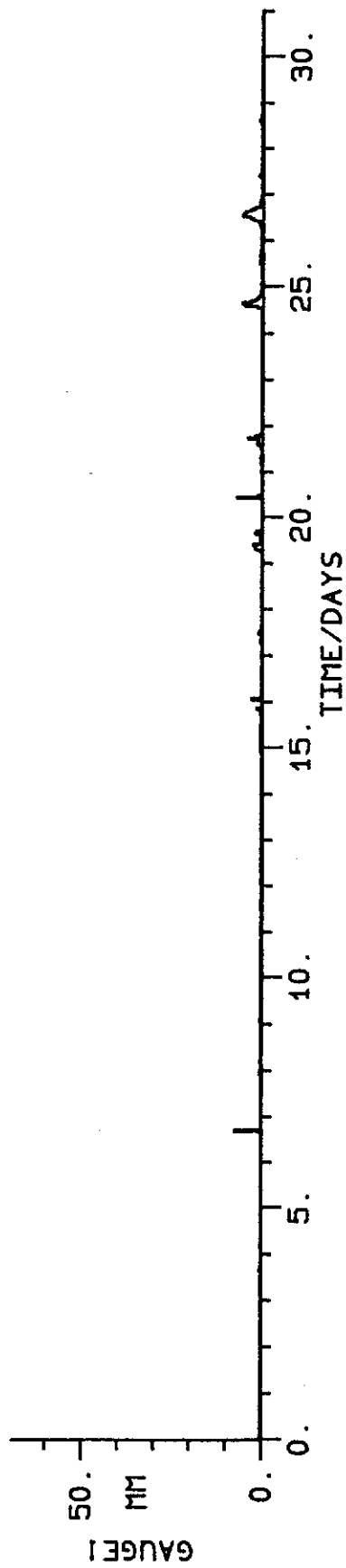
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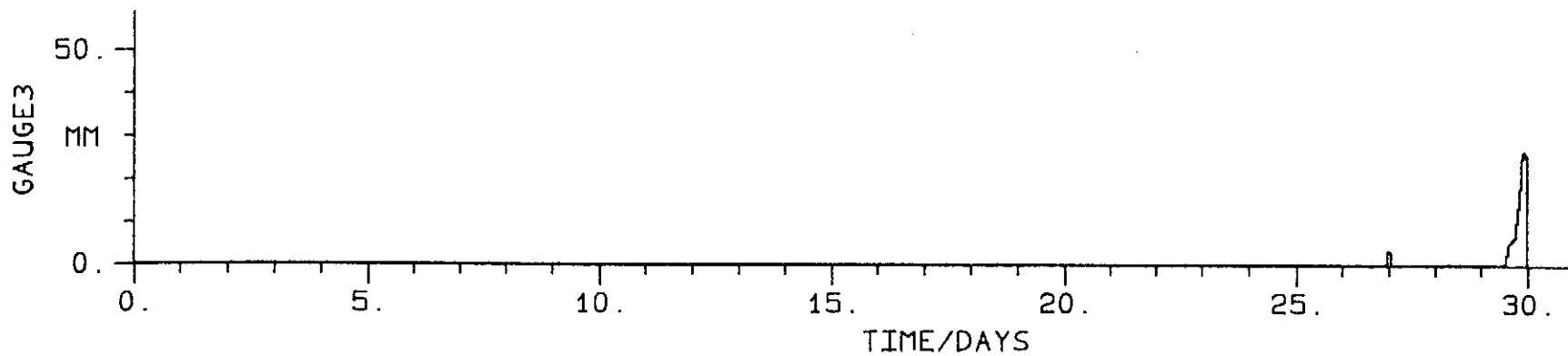
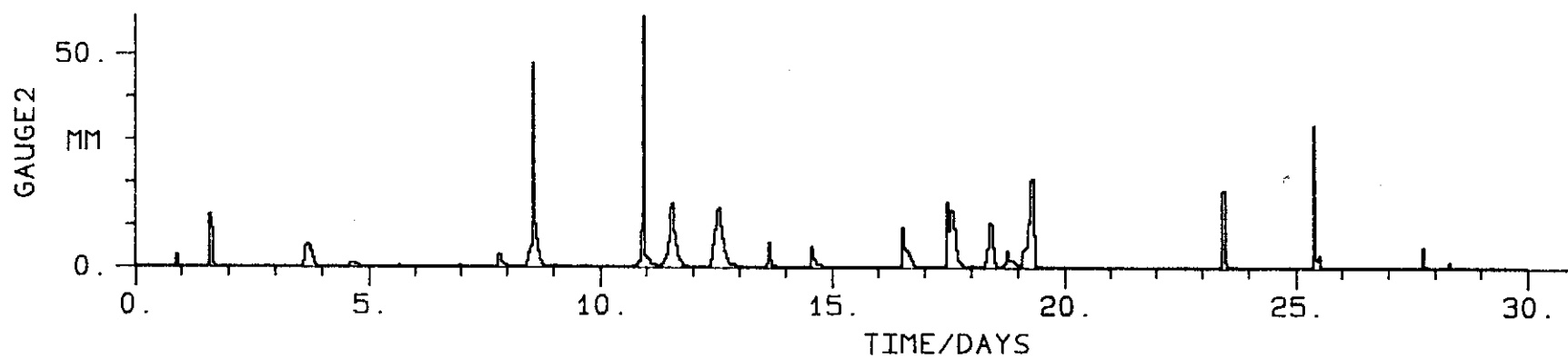
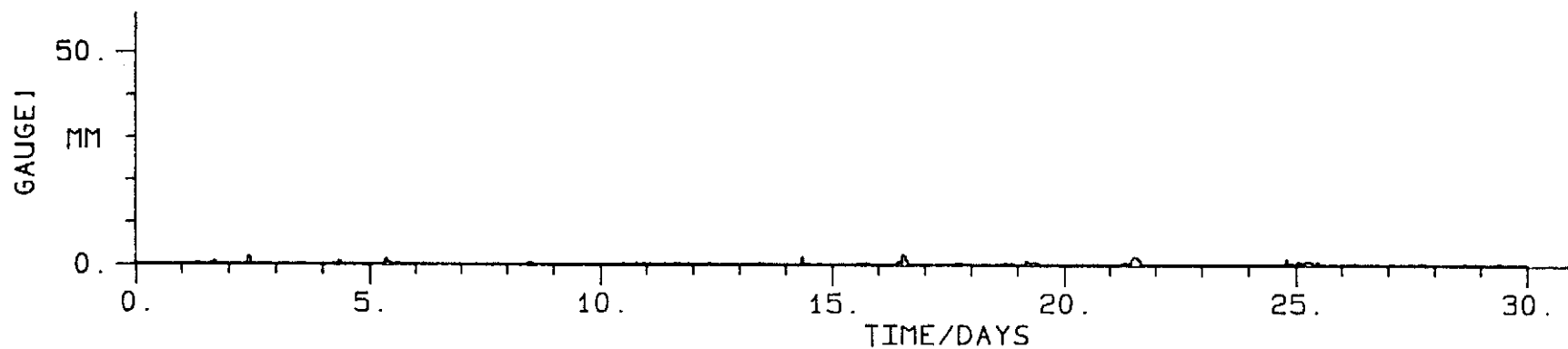
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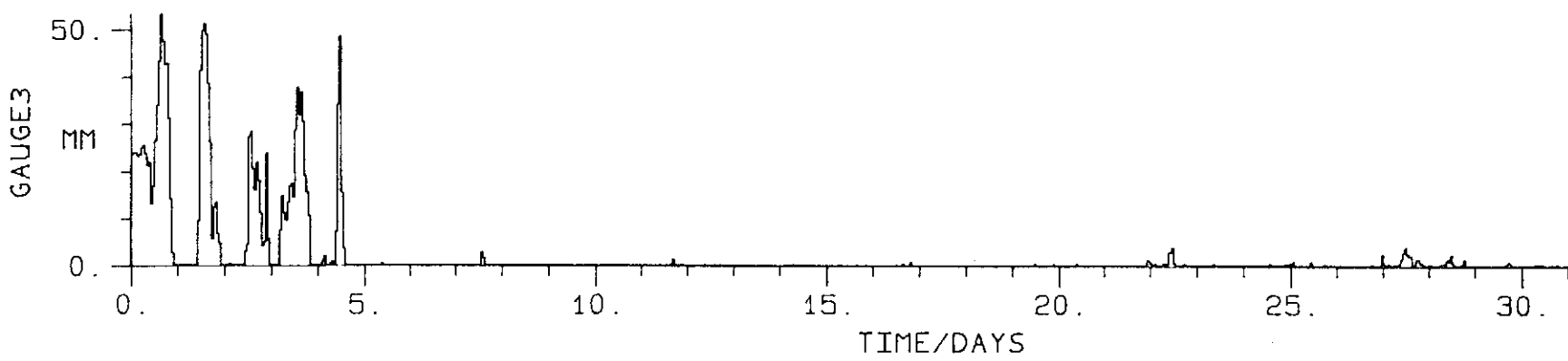
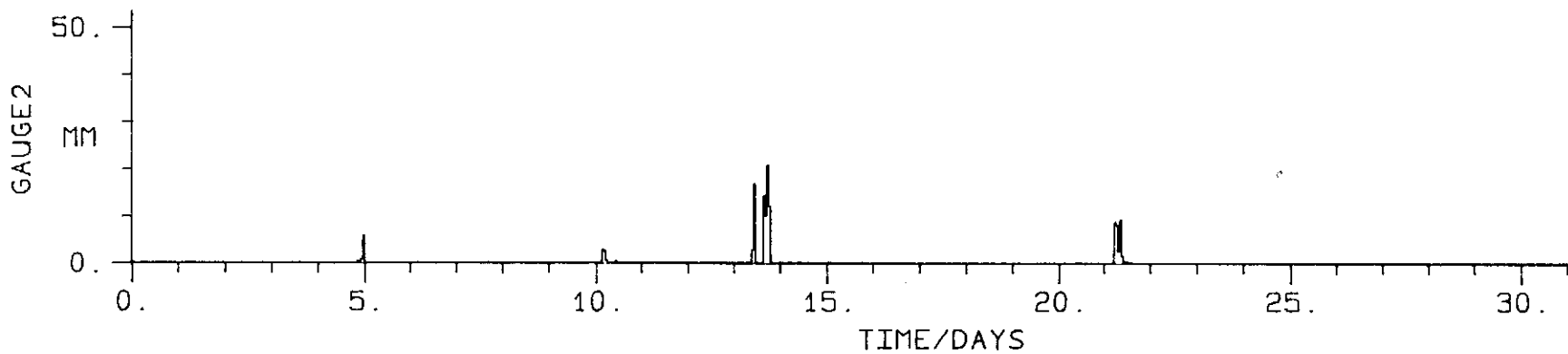
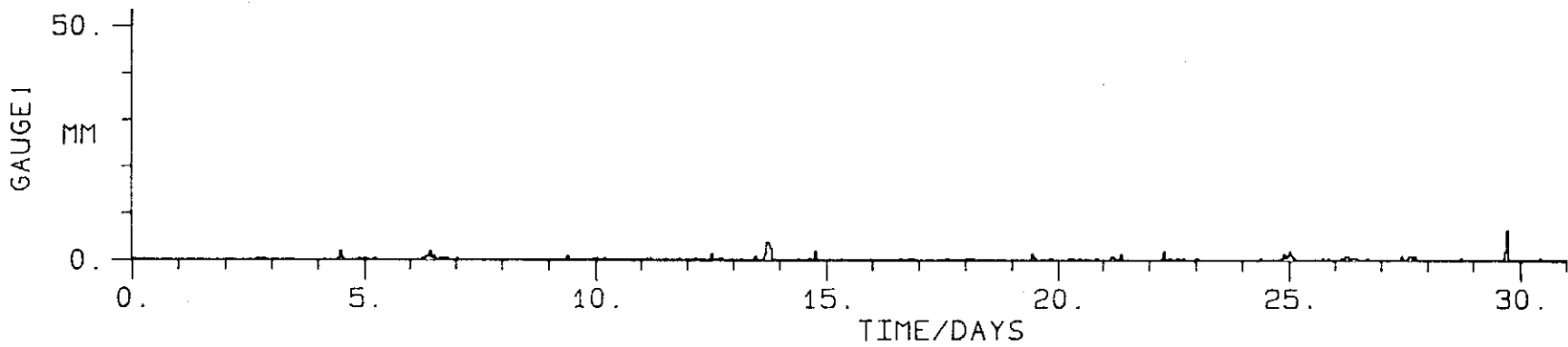
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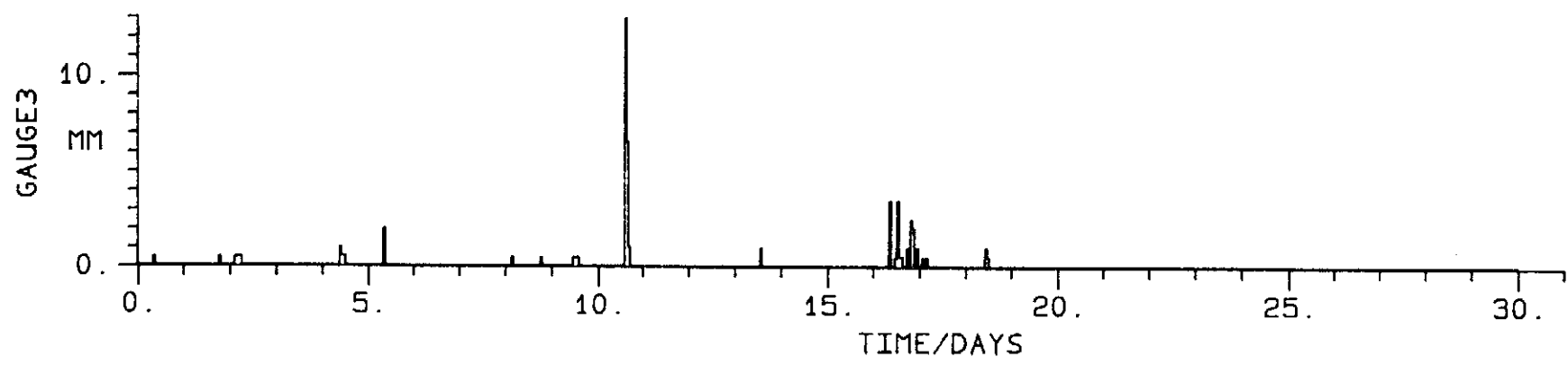
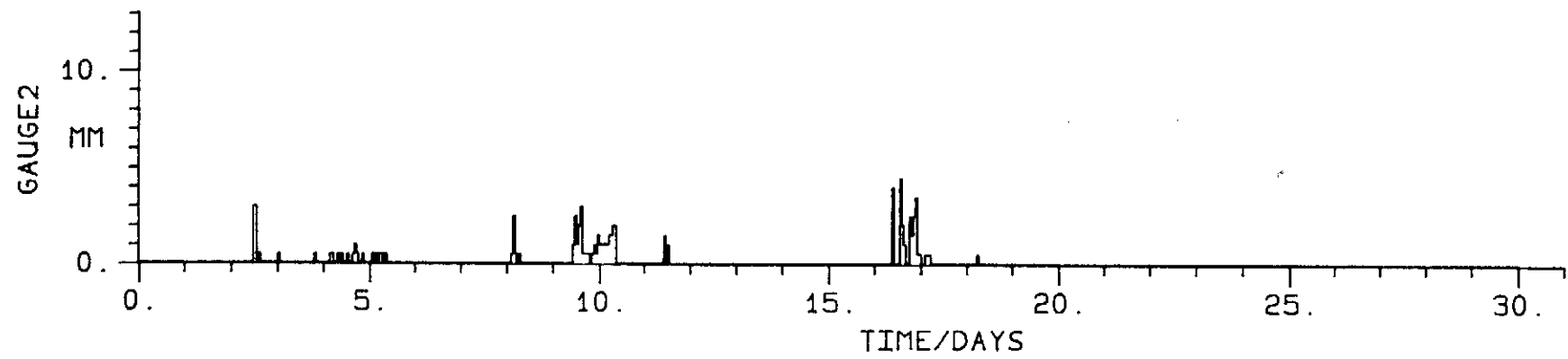
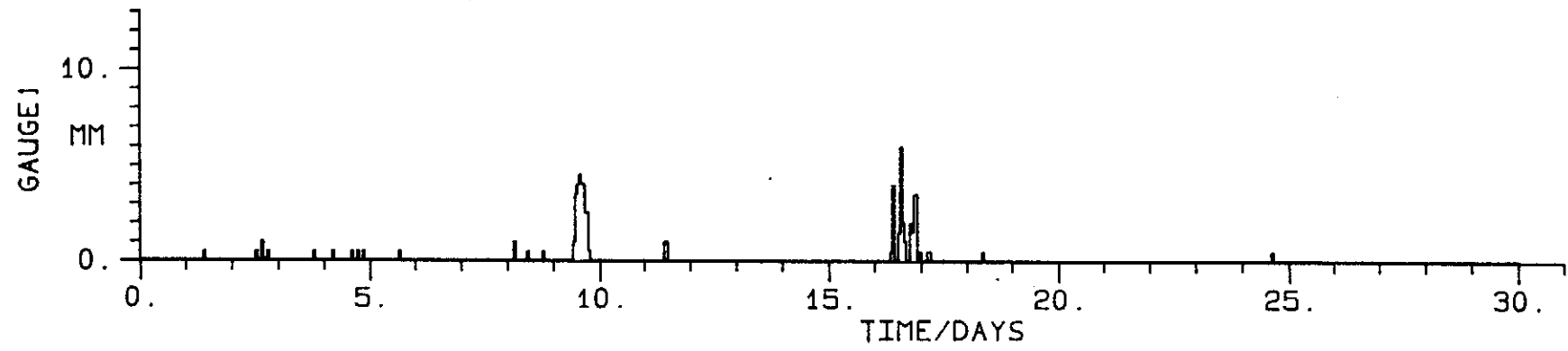
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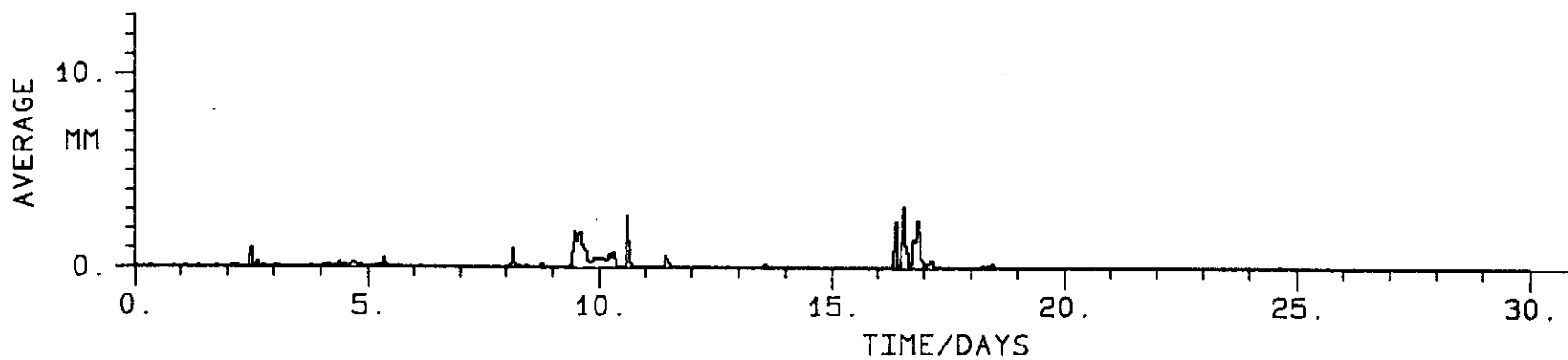
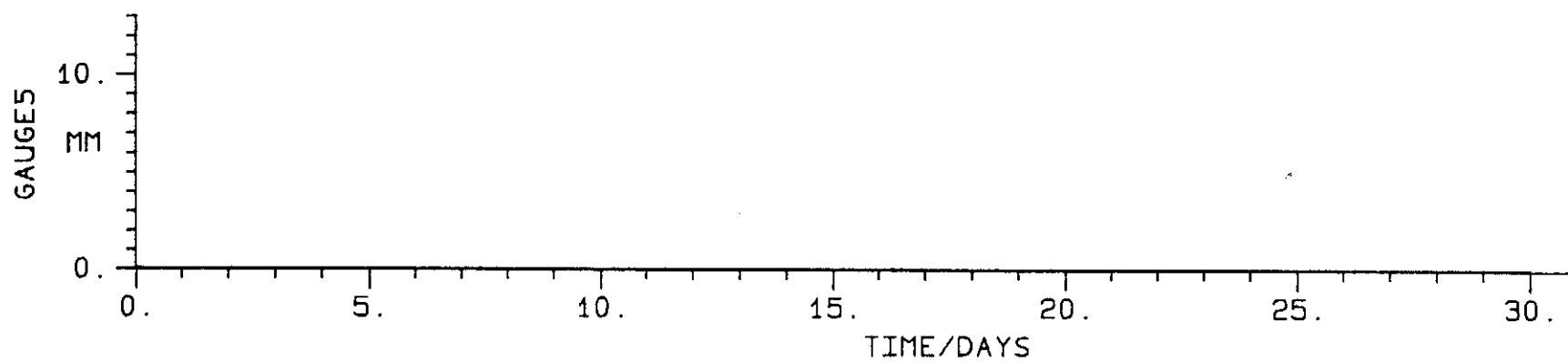
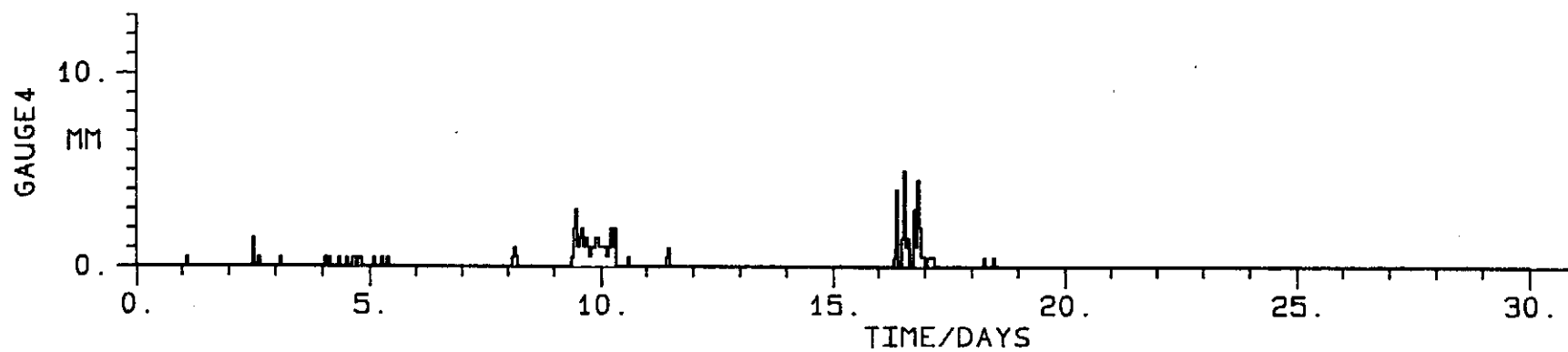
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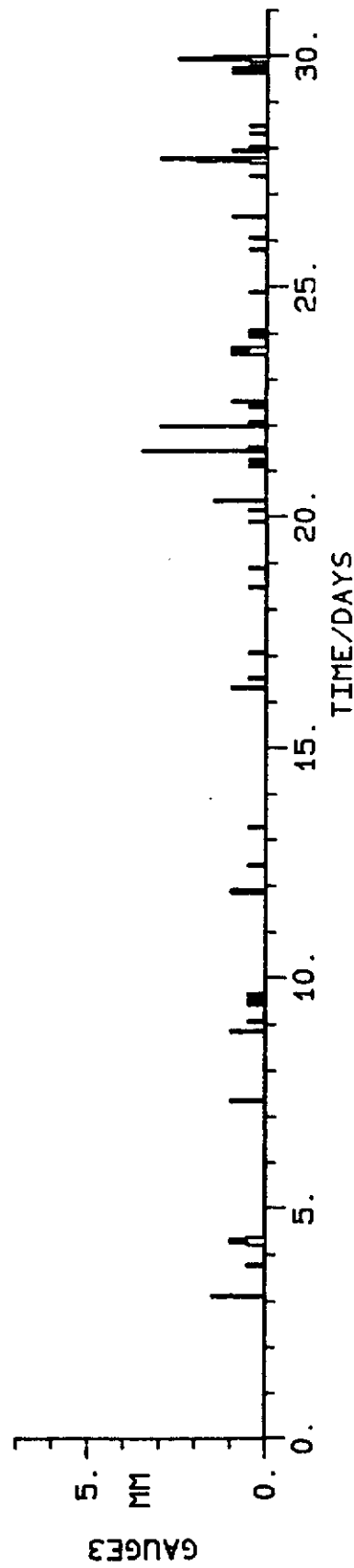
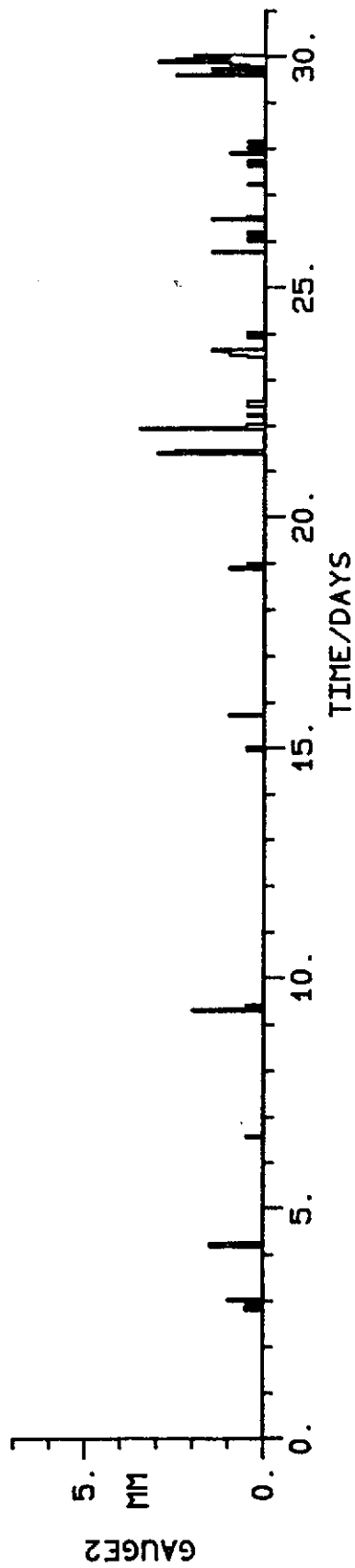
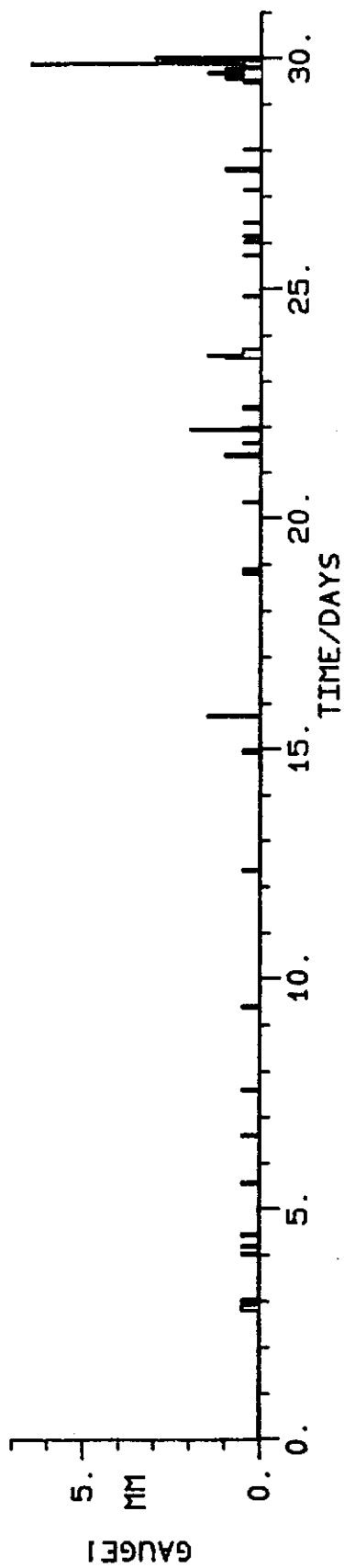
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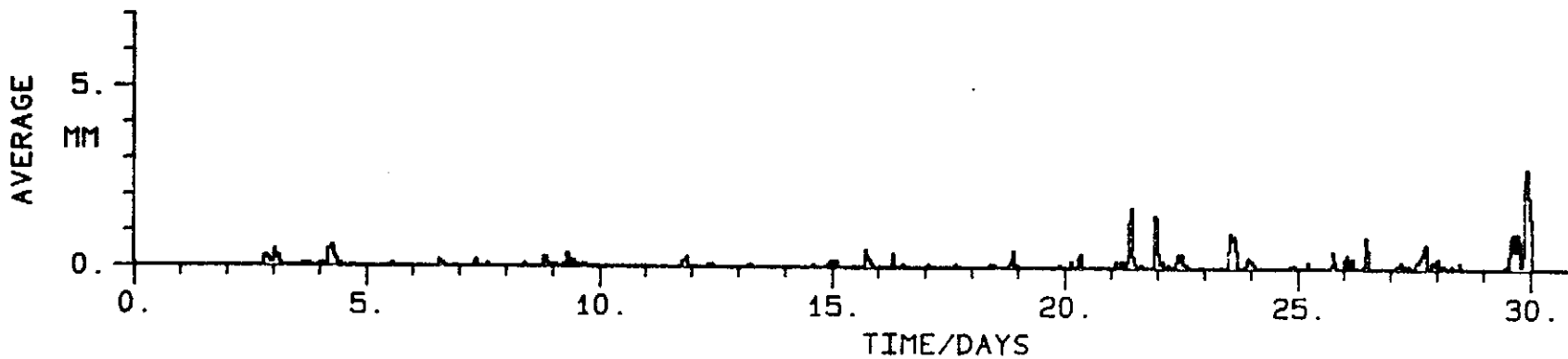
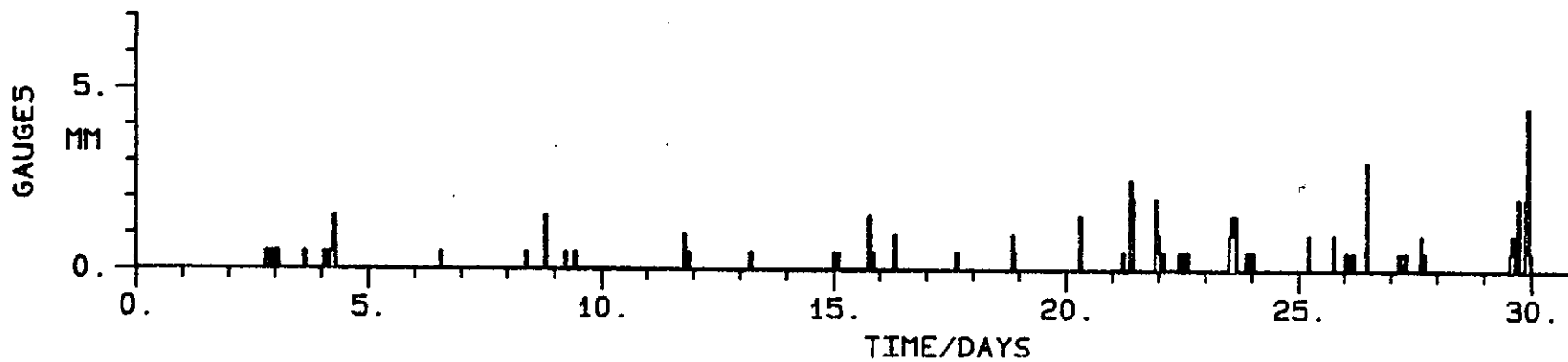
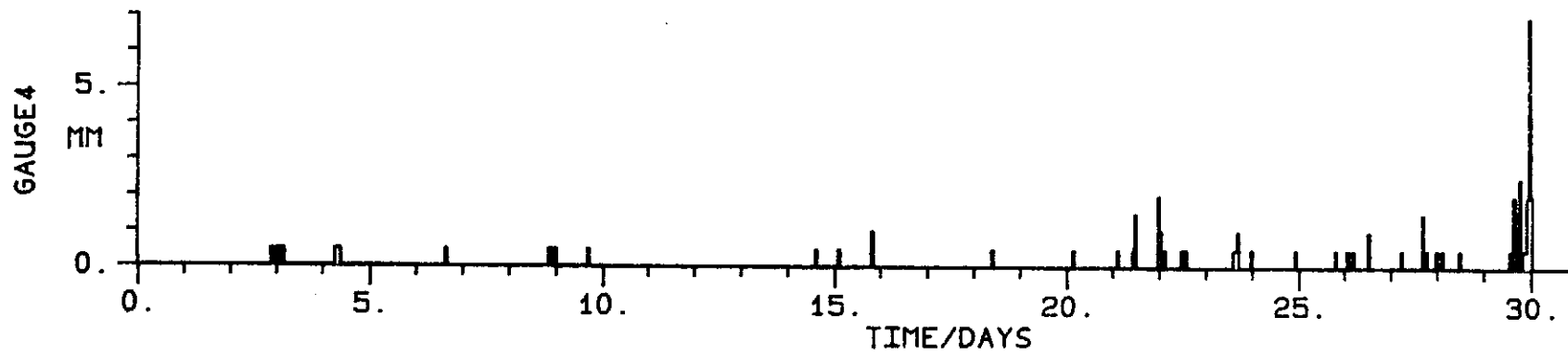
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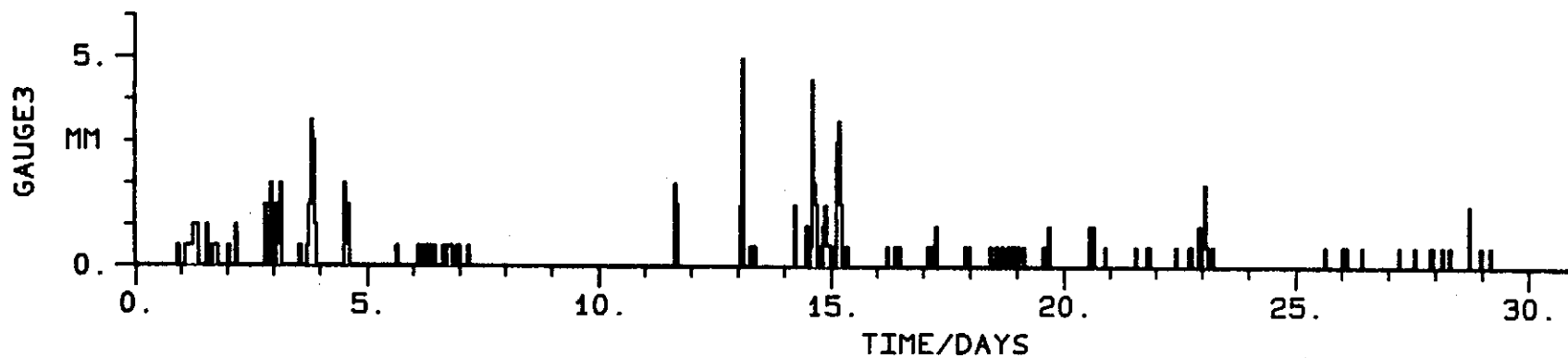
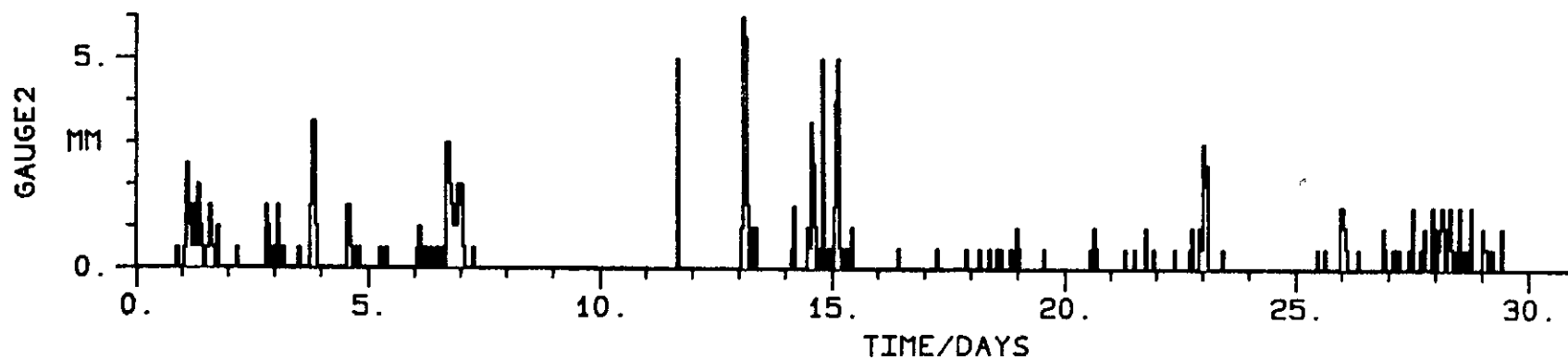
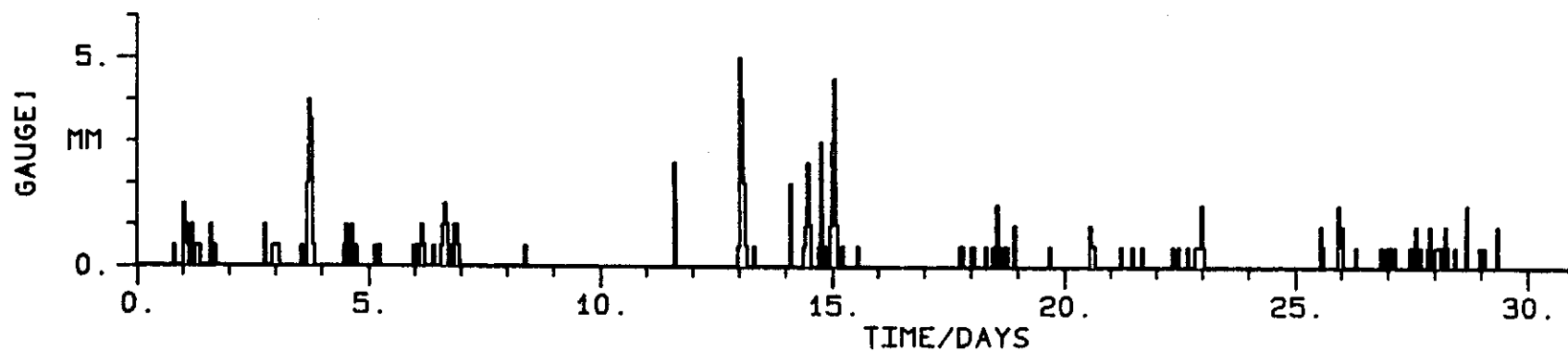
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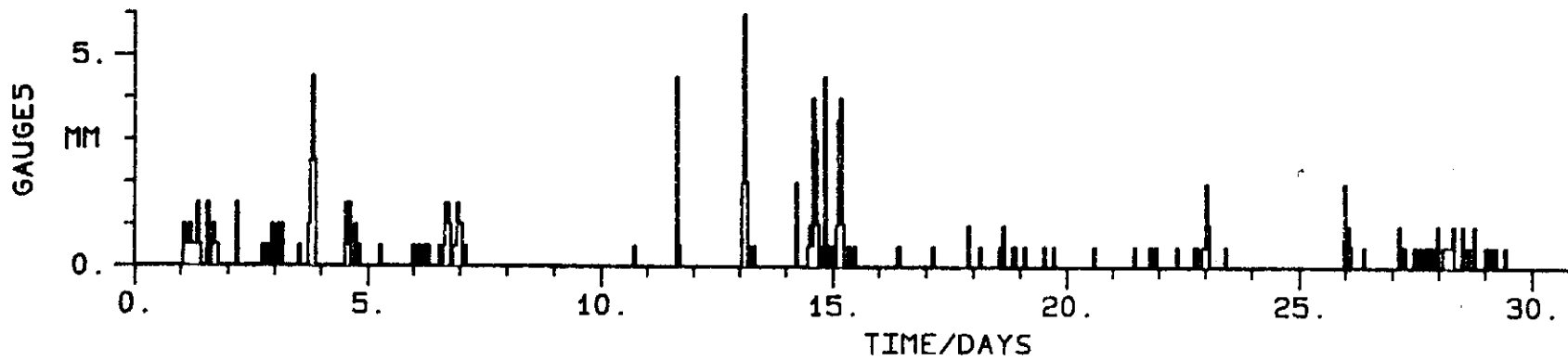
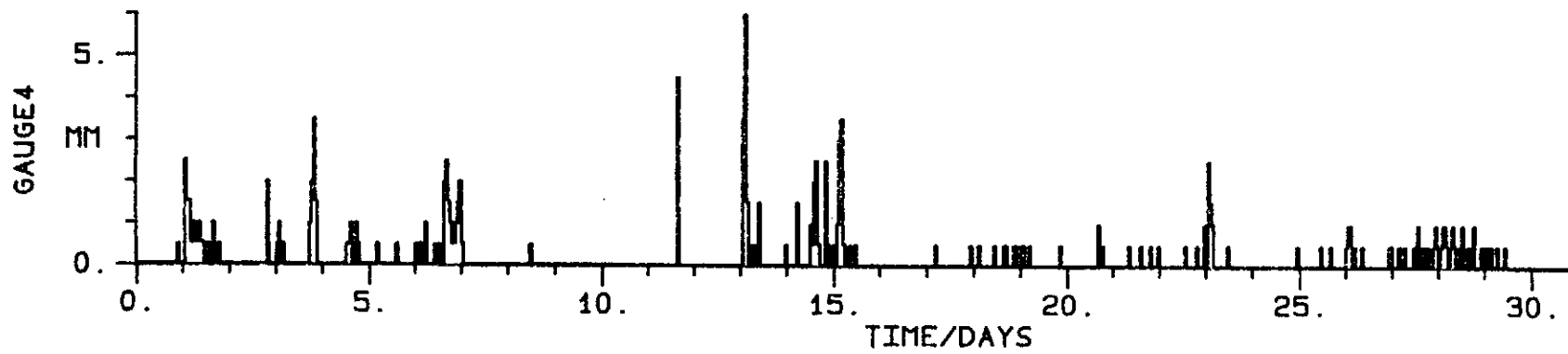
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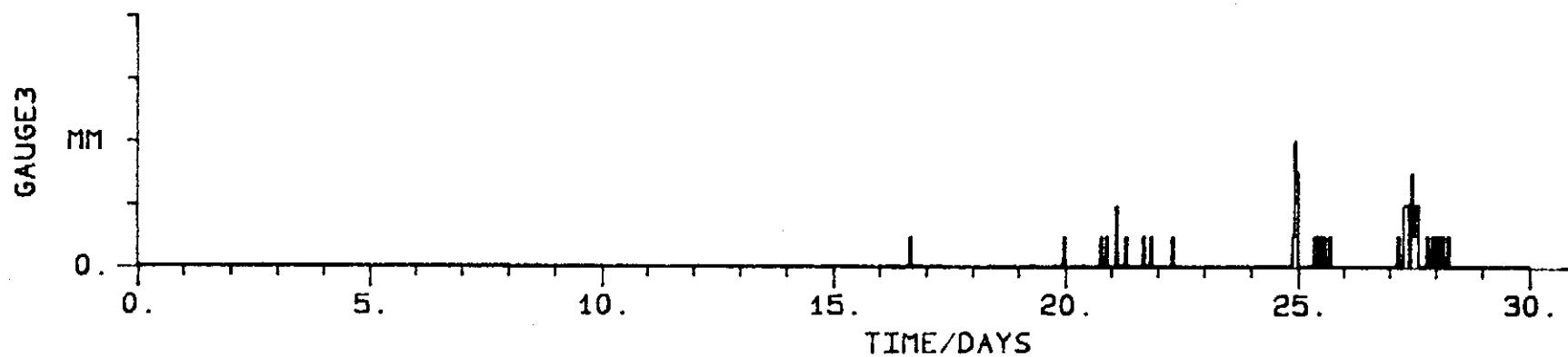
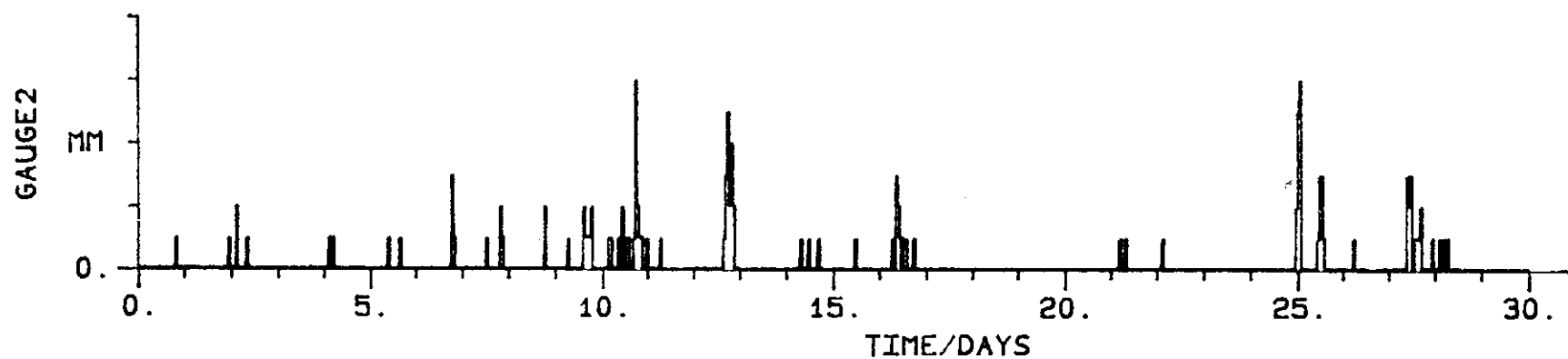
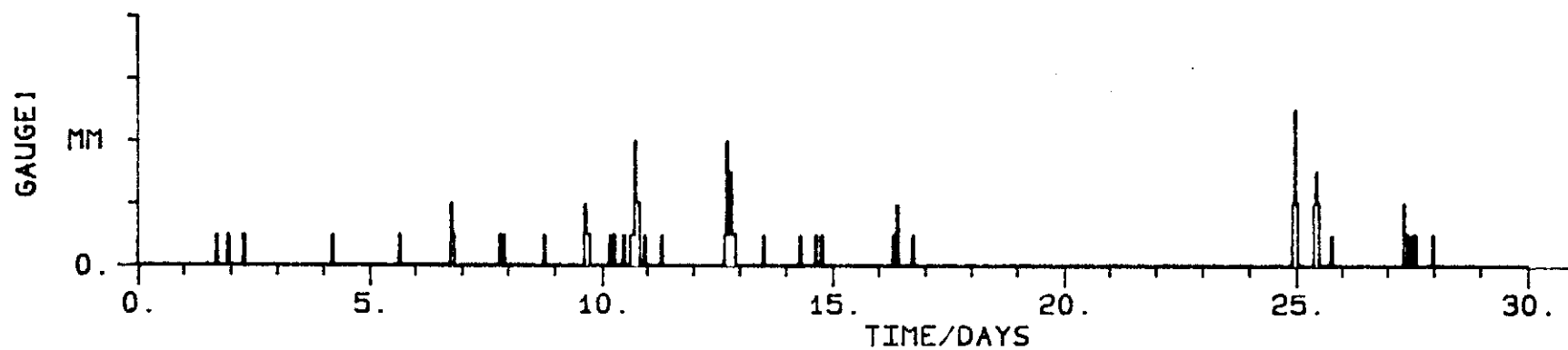
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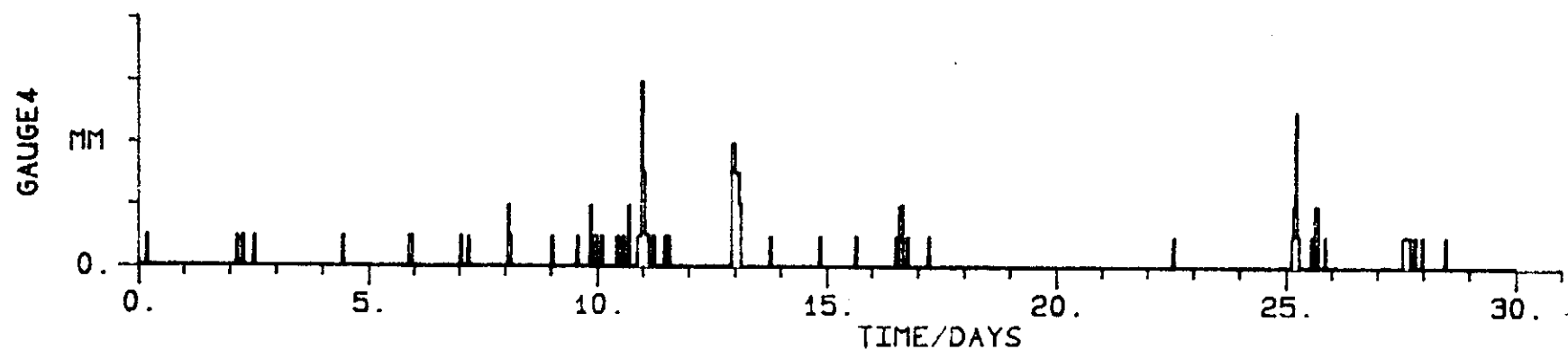
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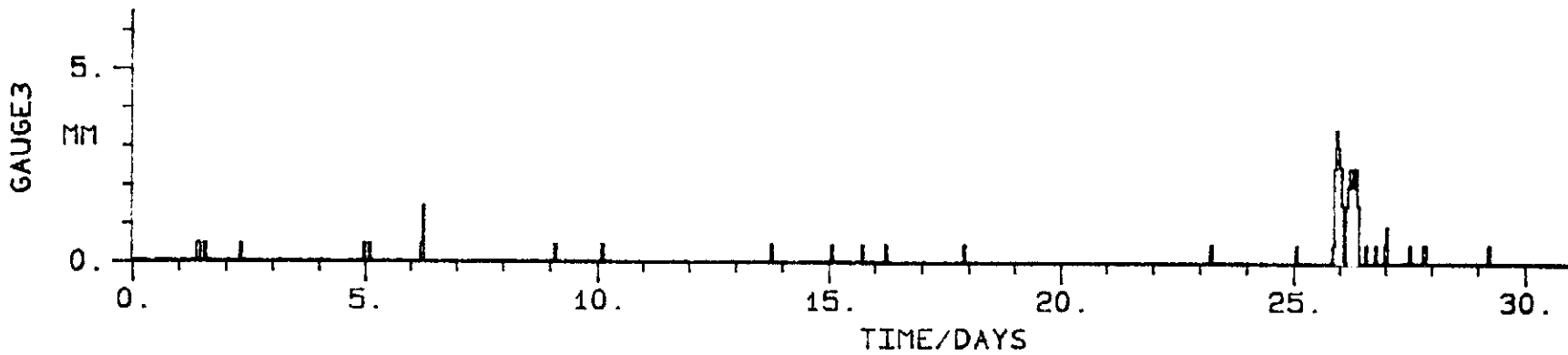
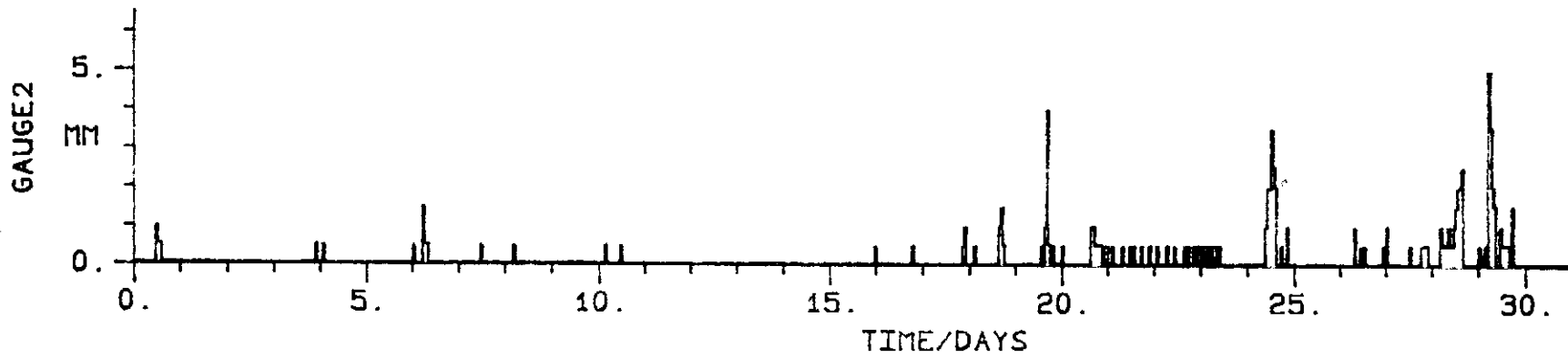
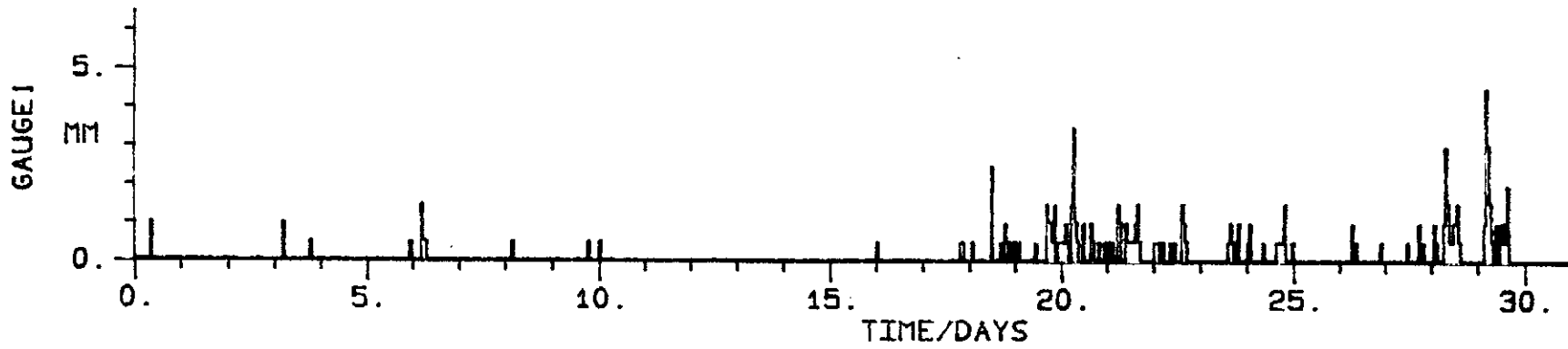
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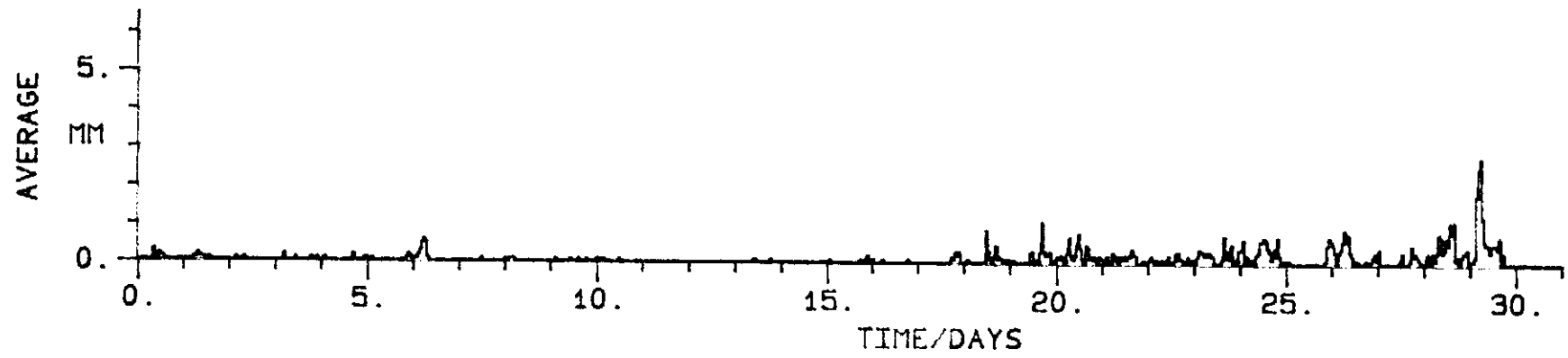
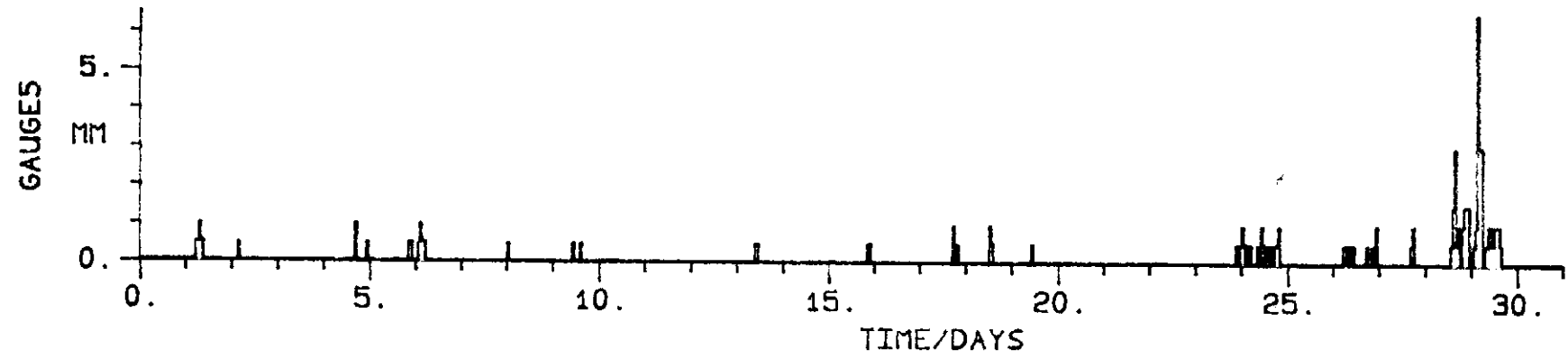
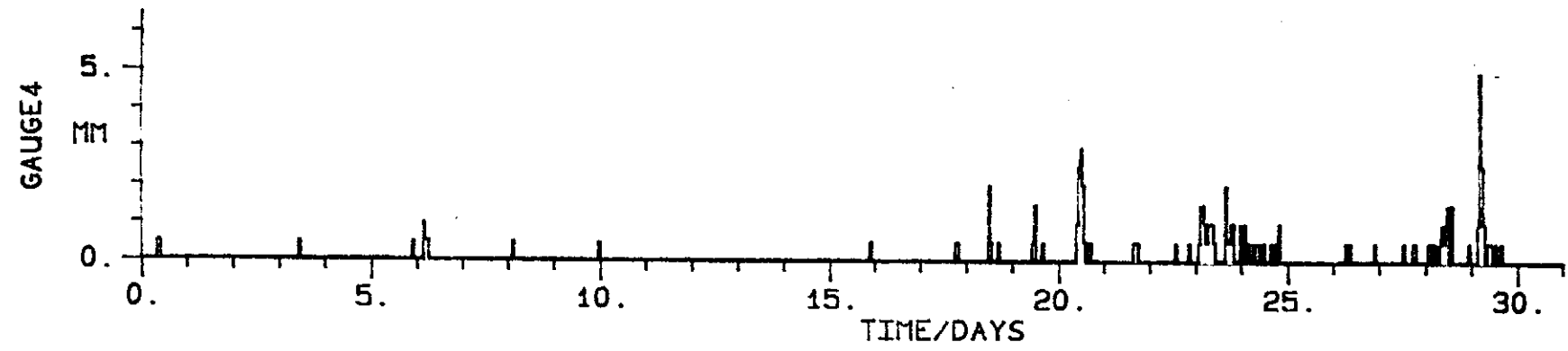
ALLT @ MHARCAIDH-RAINFALL

OCT86



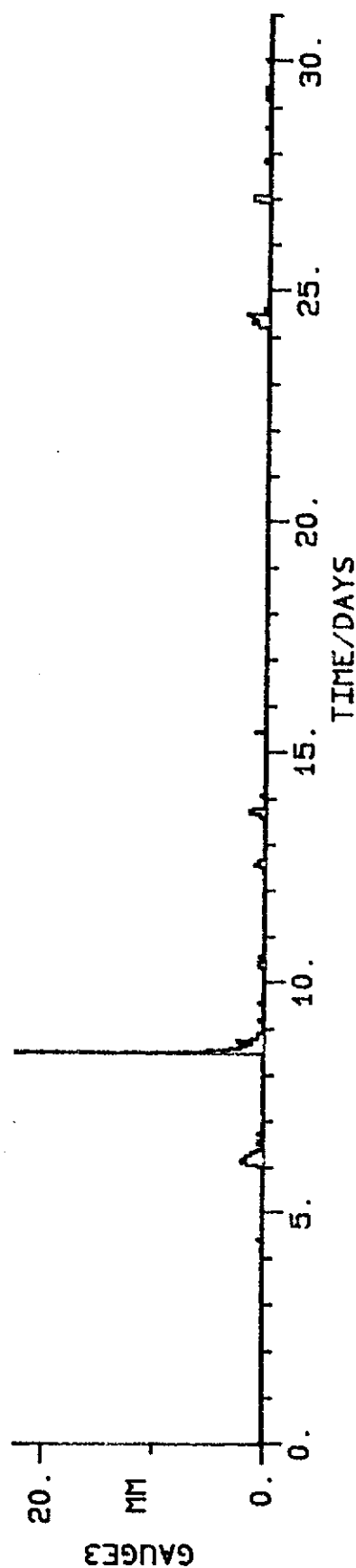
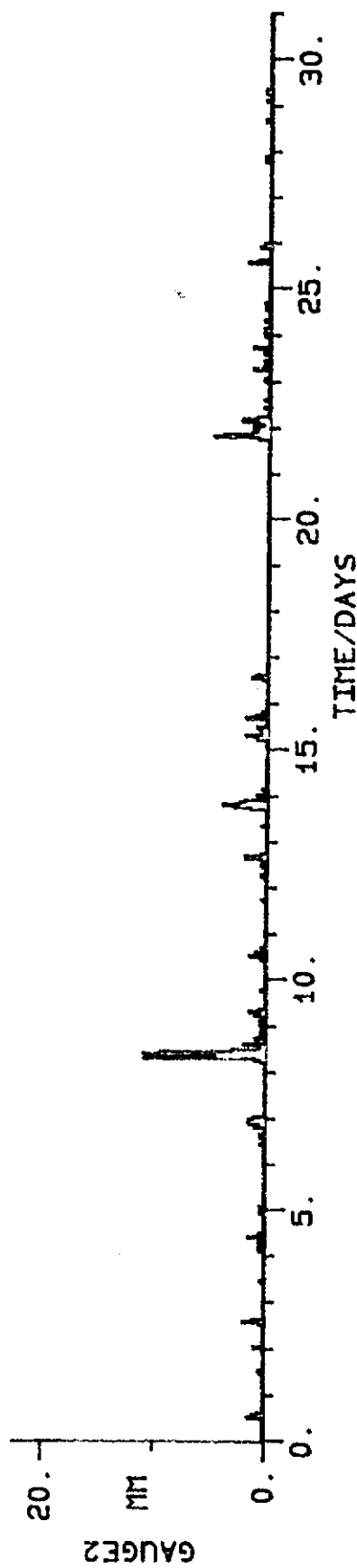
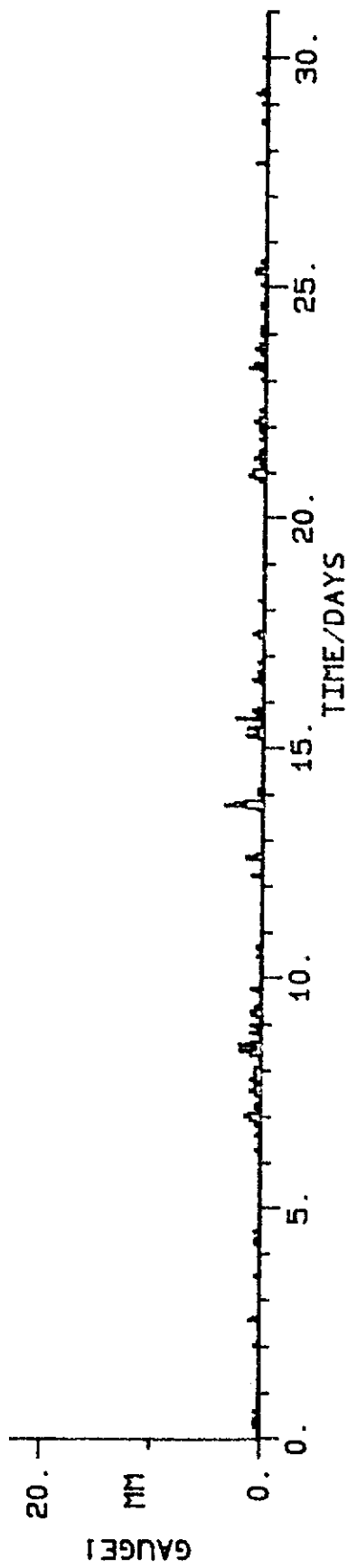
ALLT @ MHARCAIDH-RAINFALL

OCT86



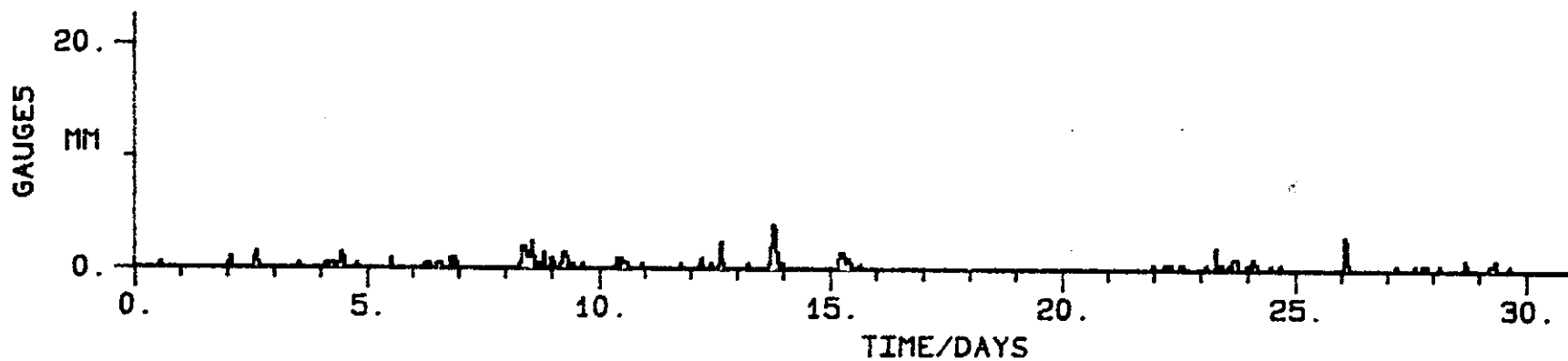
ALLT o MHARCAIDH-RAINFALL

NOV86



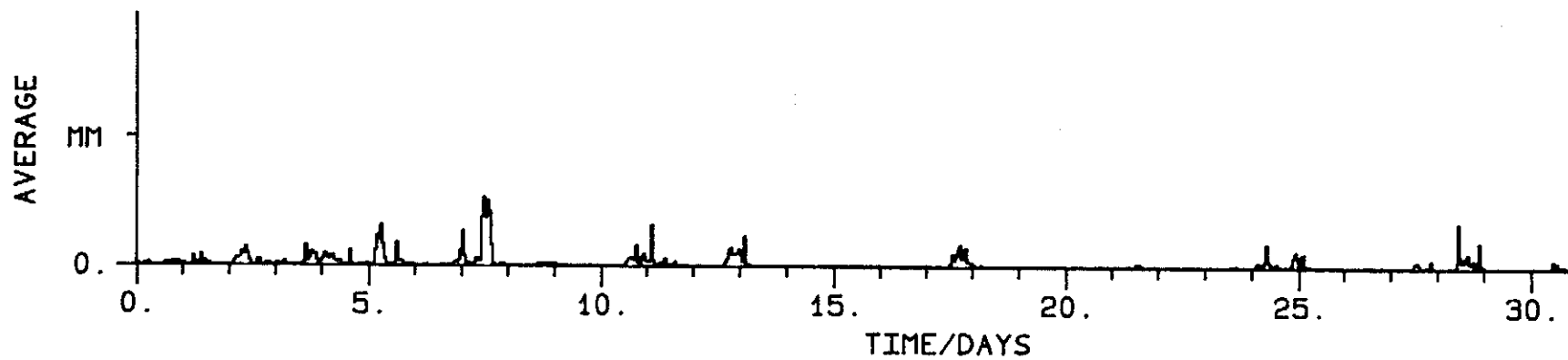
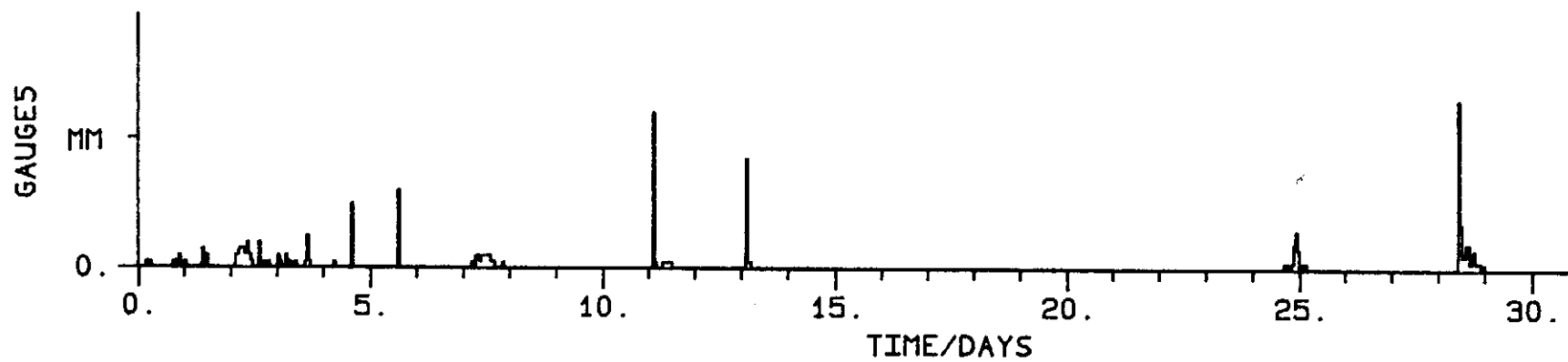
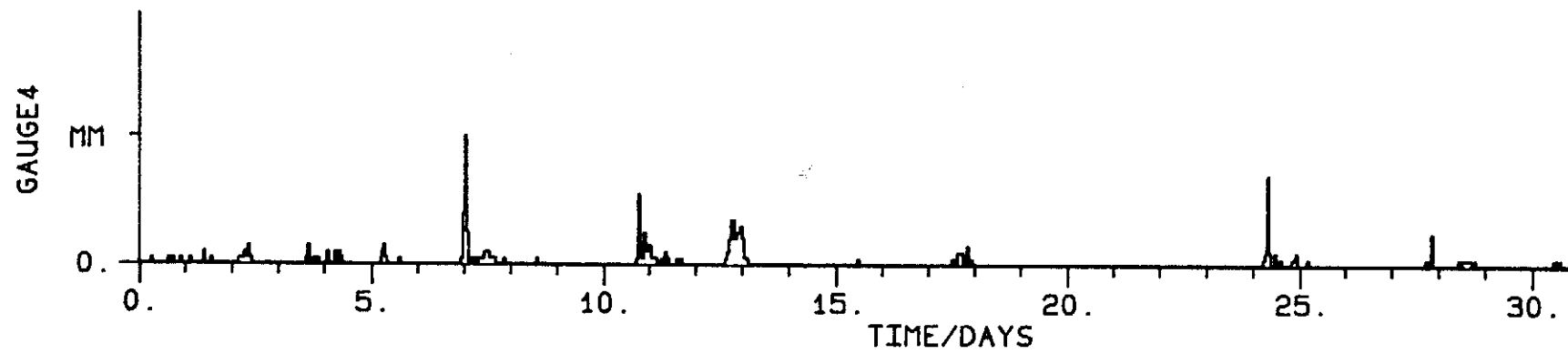
ALLT @ MHARCAIDH-RAINFALL

NOV86



ALLT @ MHARCAIDH-RAINFALL

DEC86

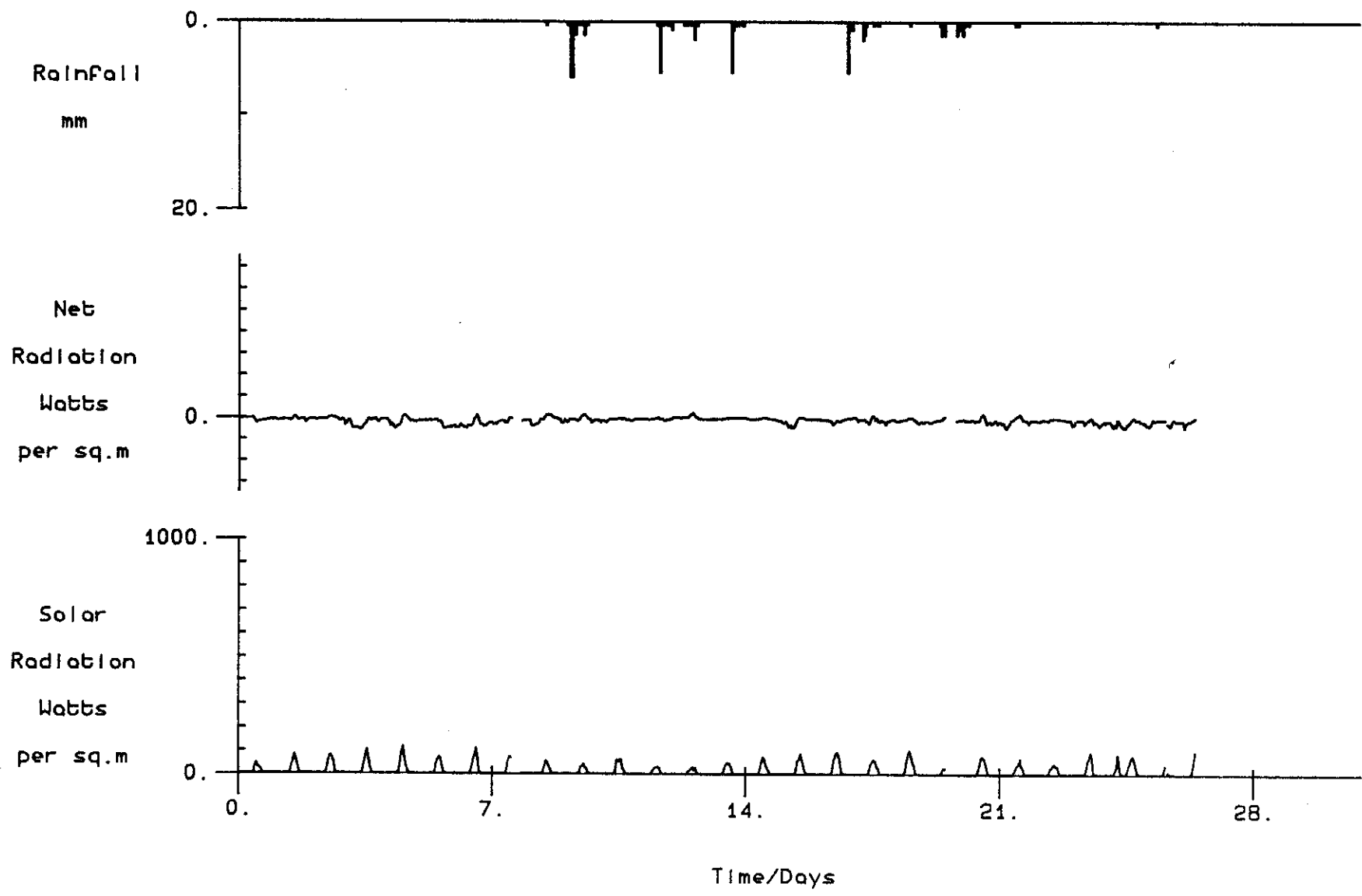


Appendix C

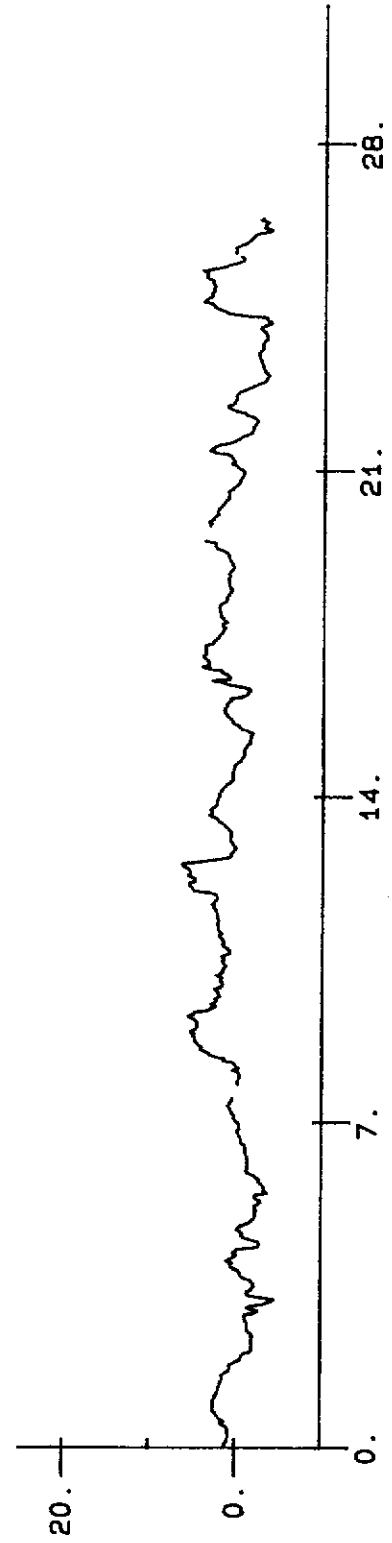
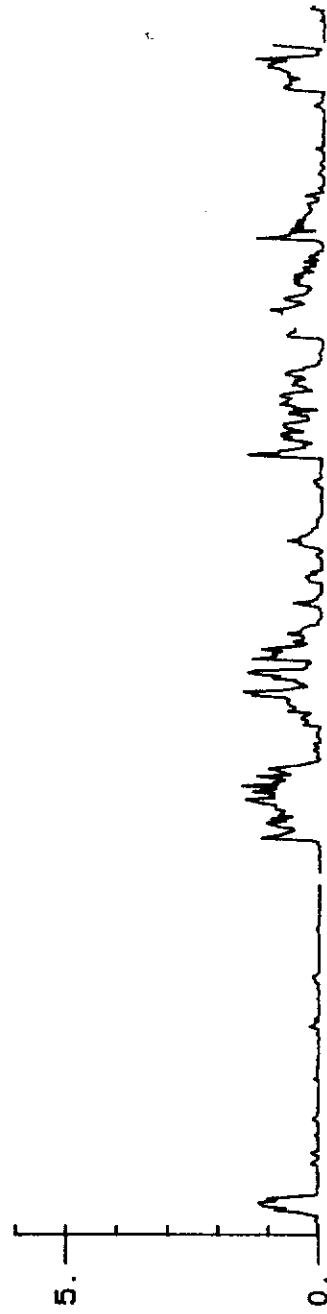
Monthly summaries of hourly meteorological data from the automatic weather station at the meteorological site in the centre of the catchment.

ALLT A MHARCAIDH AWS DATA

JAN86



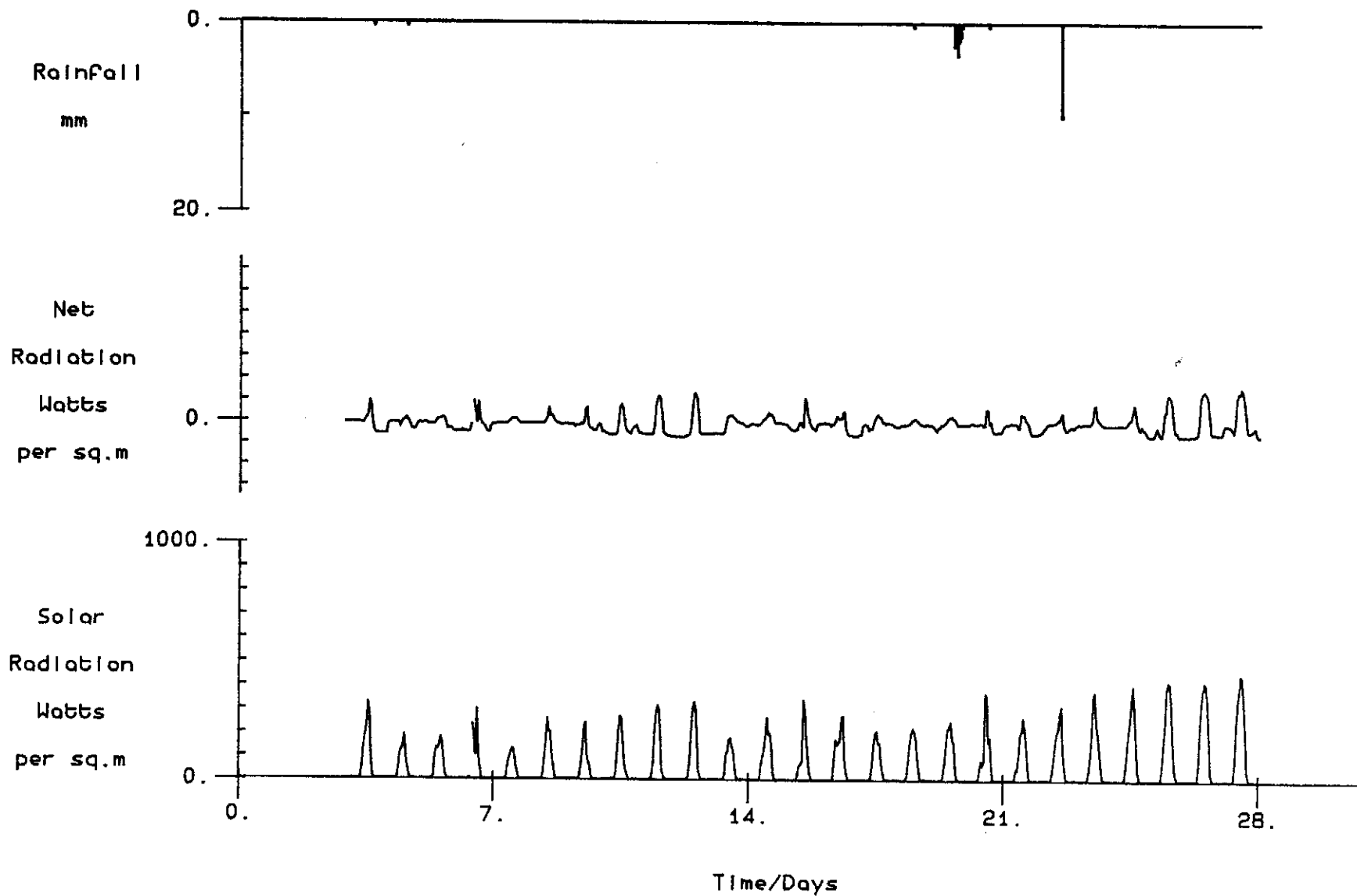
ALLT A MHARCAIDH AWS DATA
JAN86



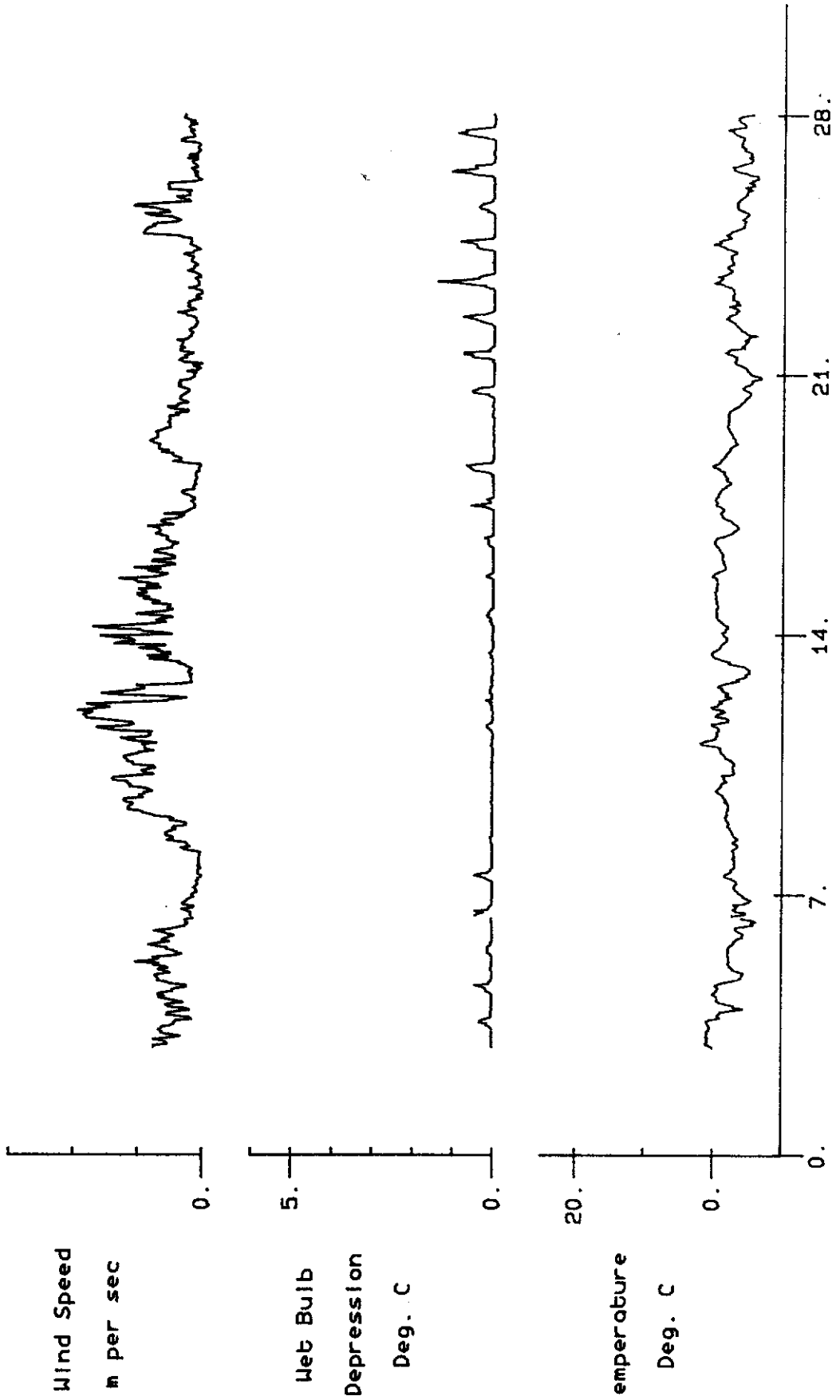
Time/Days

ALLT A MHARCAIDH AWS DATA

FEB86



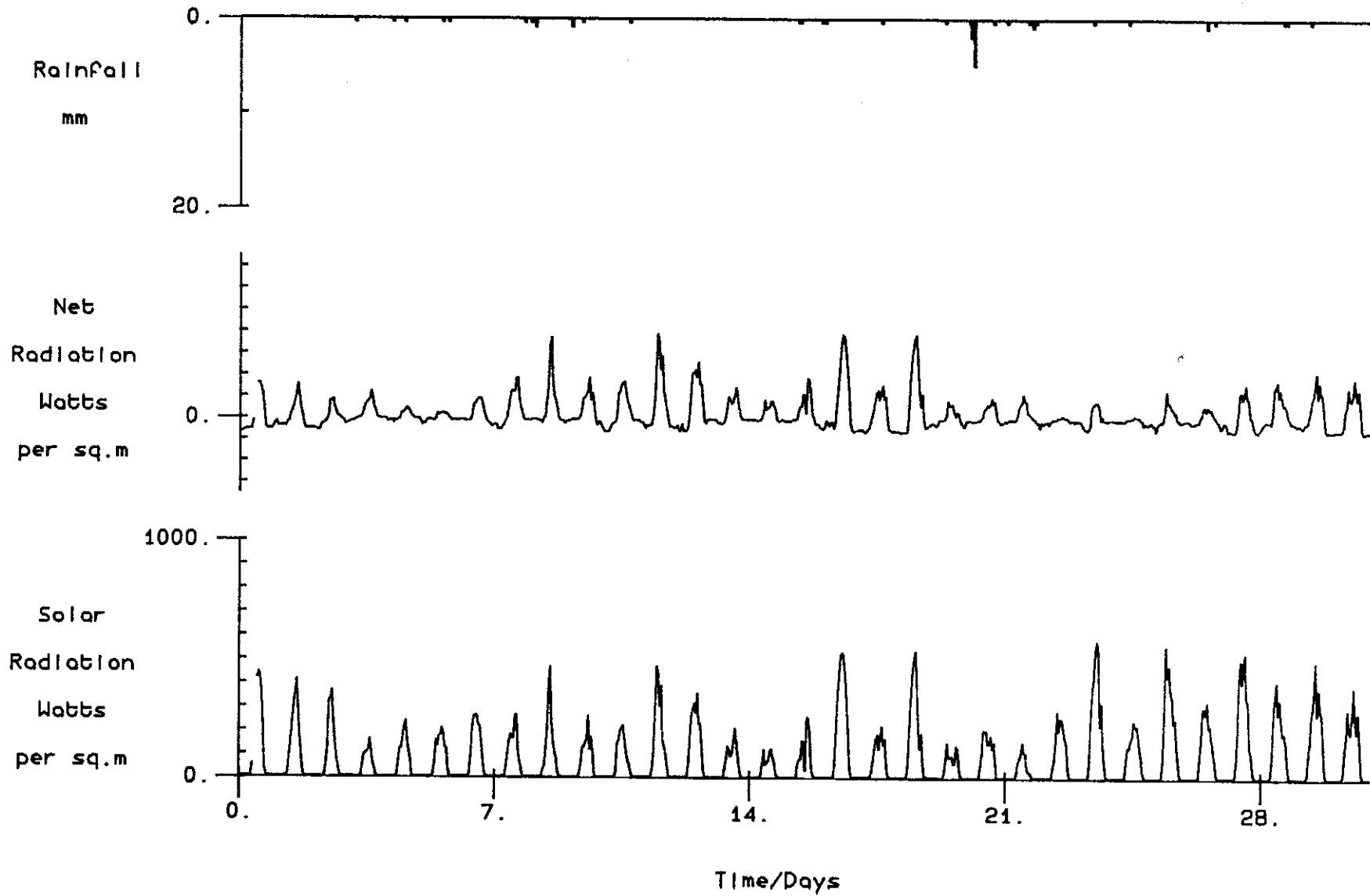
ALLT A MHARCAIDH AWS DATA
FEB86



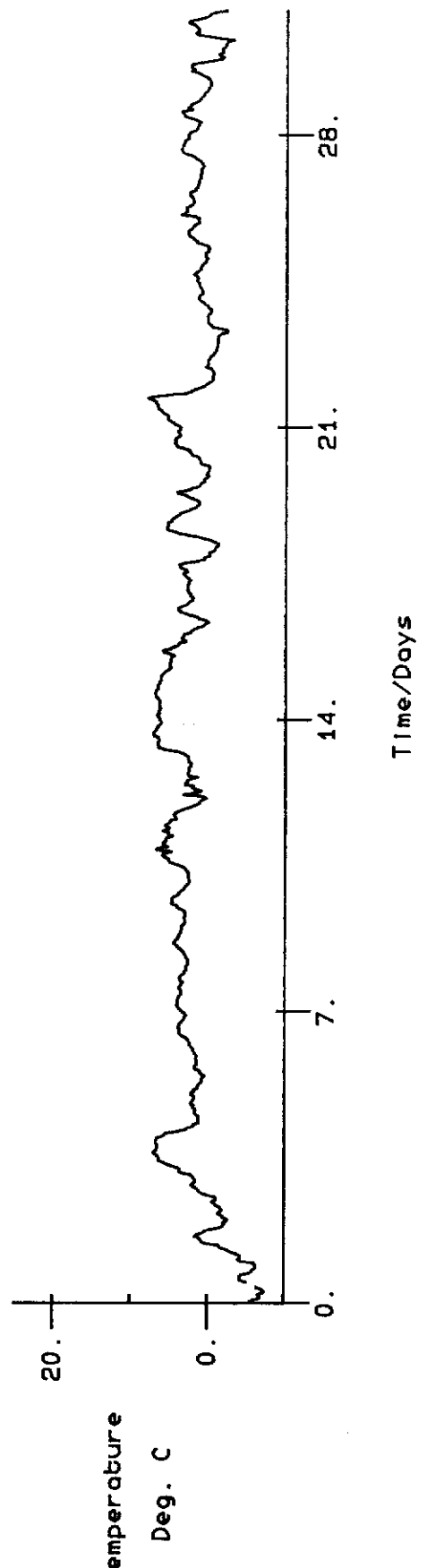
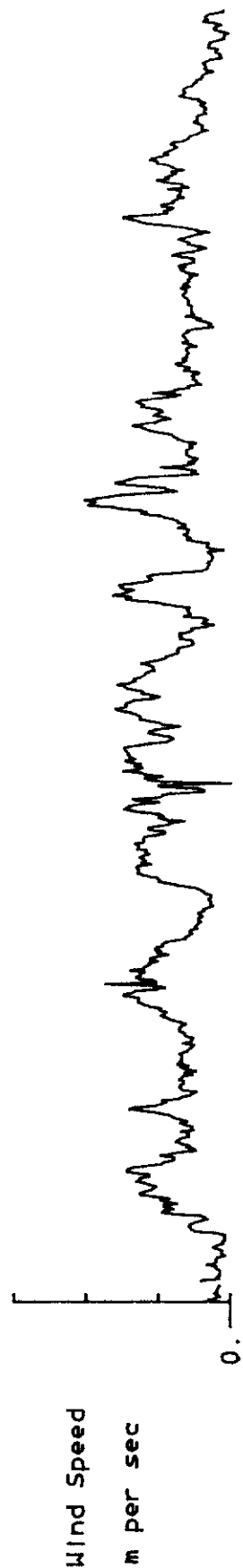
Time/Days

ALLT A MHARCAIDH AWS DATA

MAR86

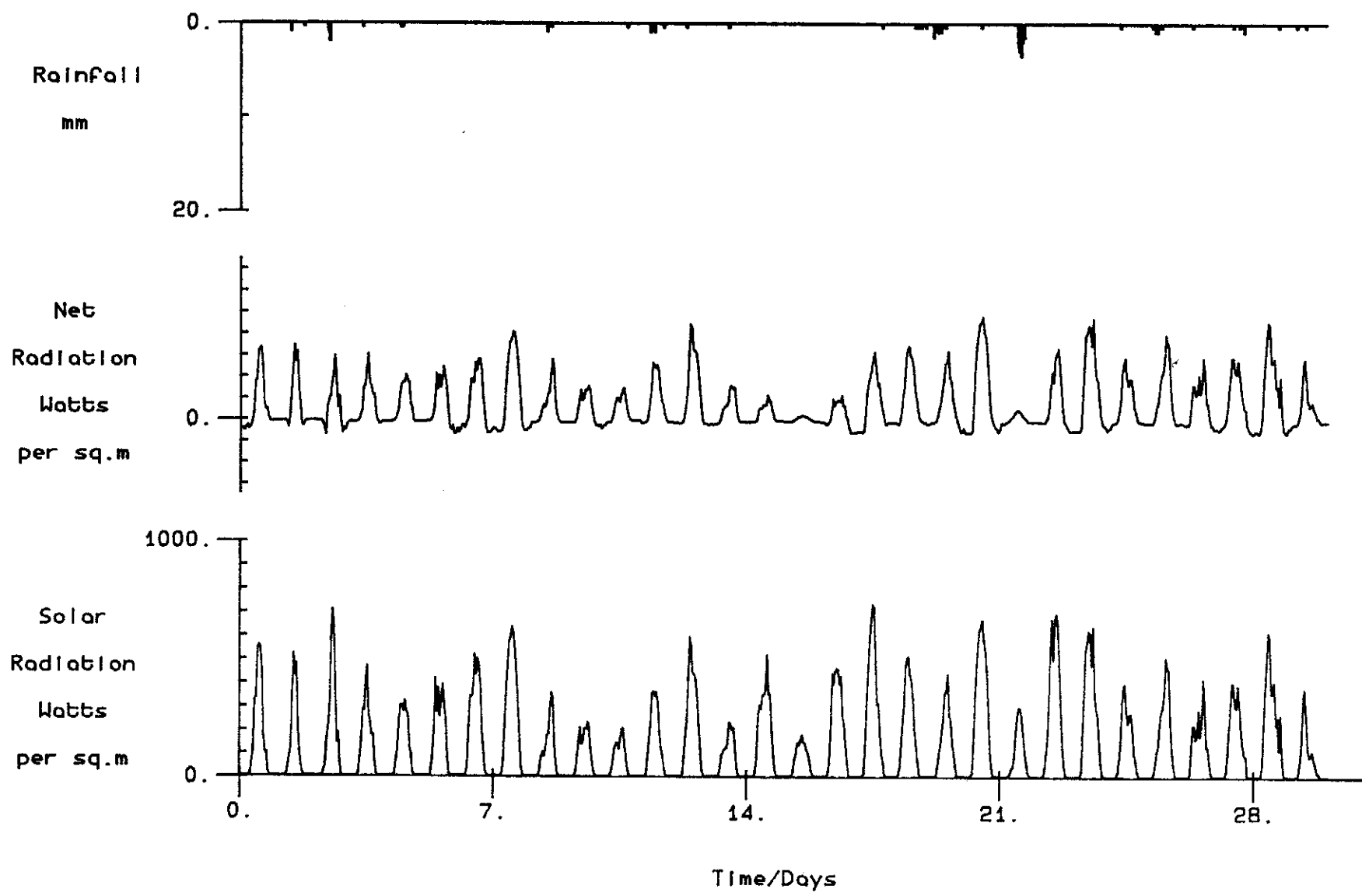


ALLT A MHARCAIDH AWS DATA
MAR86

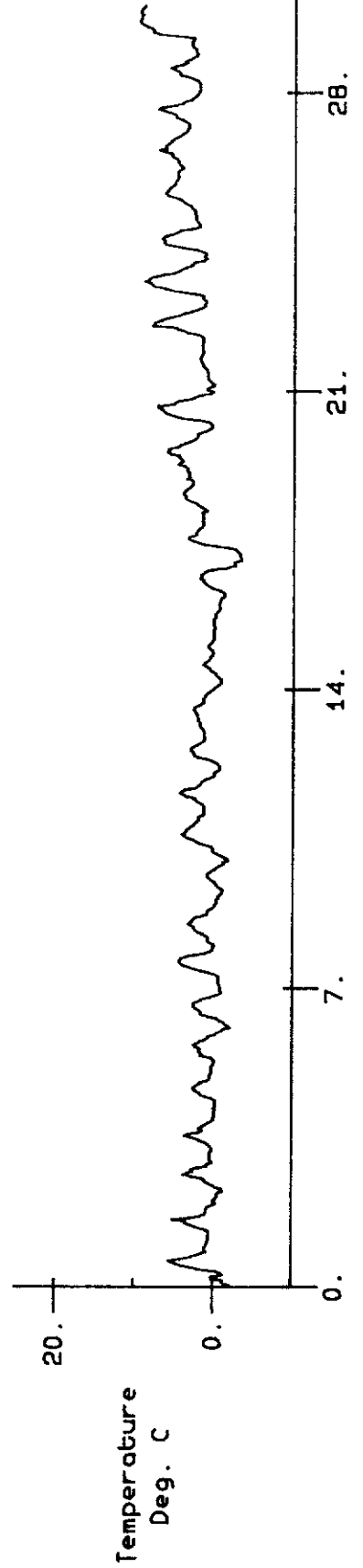
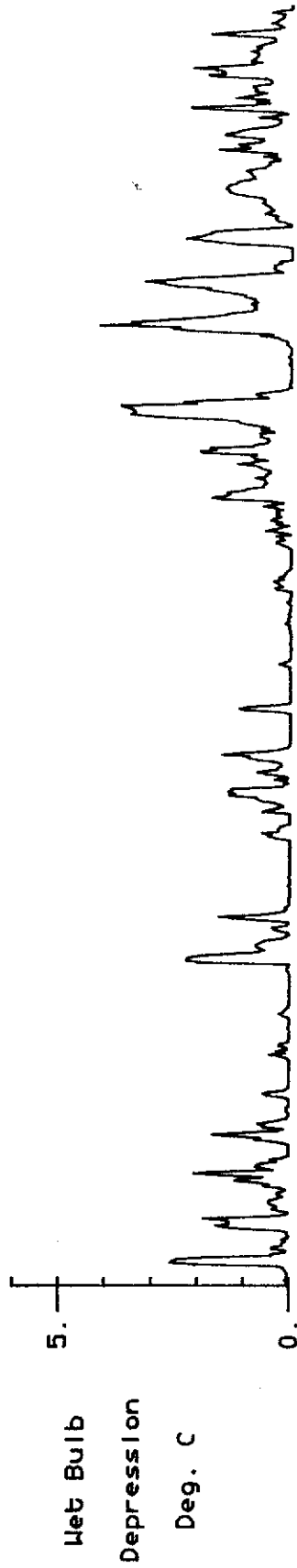


ALLT A MHARCAIDH AWS DATA

APR86

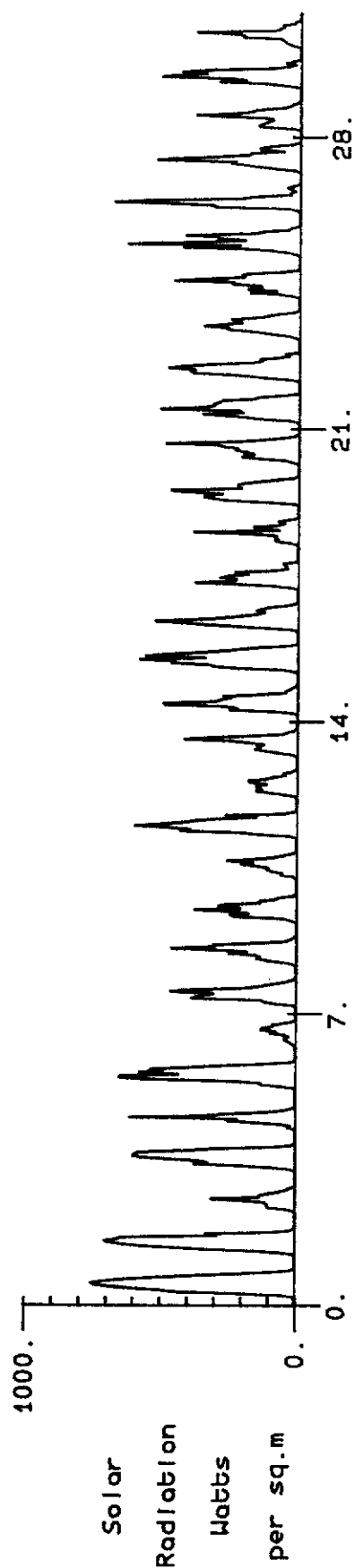
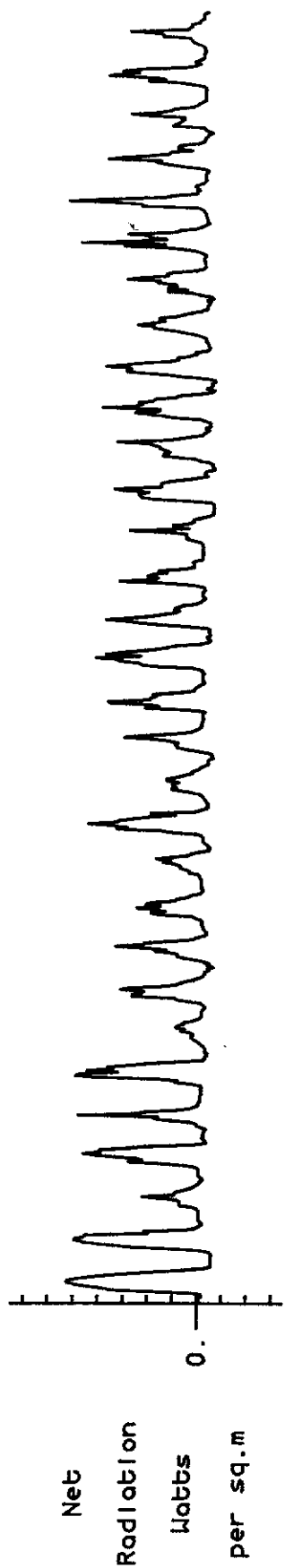
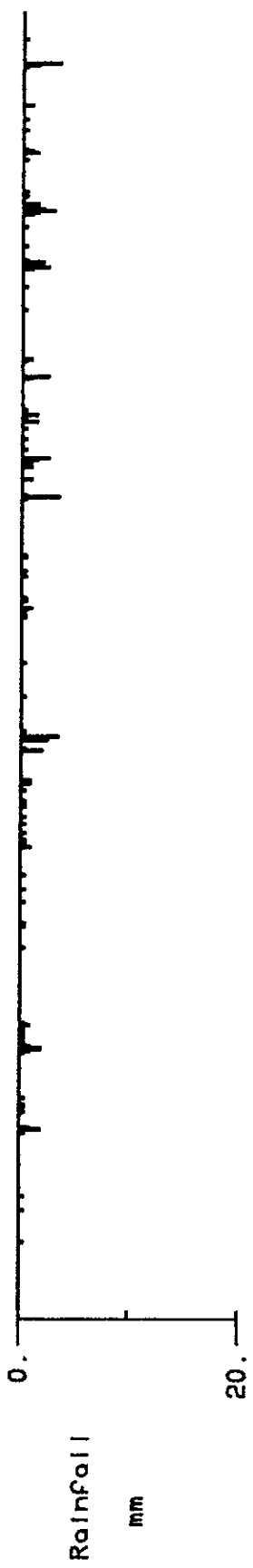


ALLT A MHARCAIDH AWS DATA
APR86

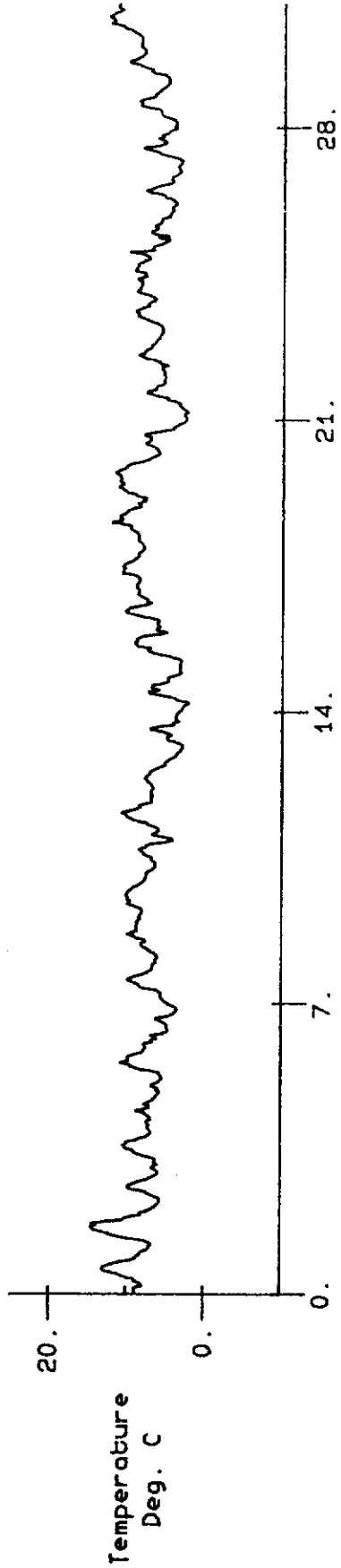
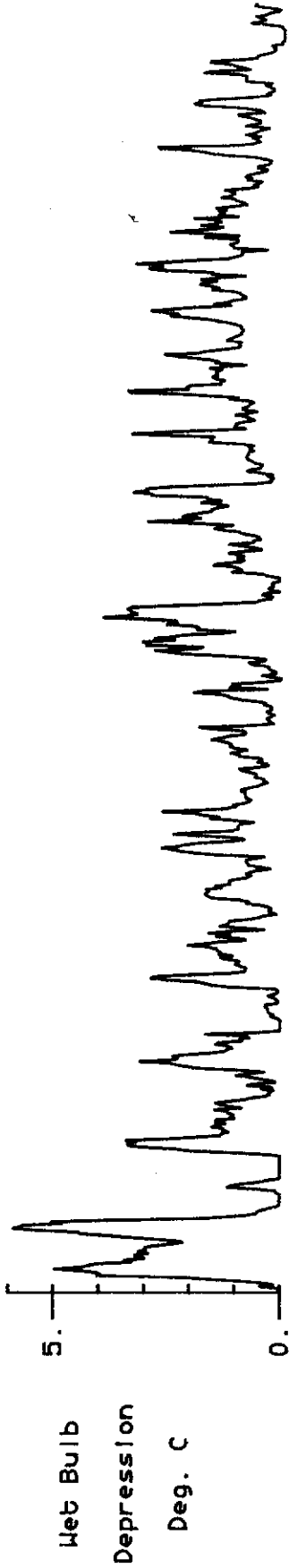


Time/Days

ALLT A MHARCAIDH AWS DATA
MAY86

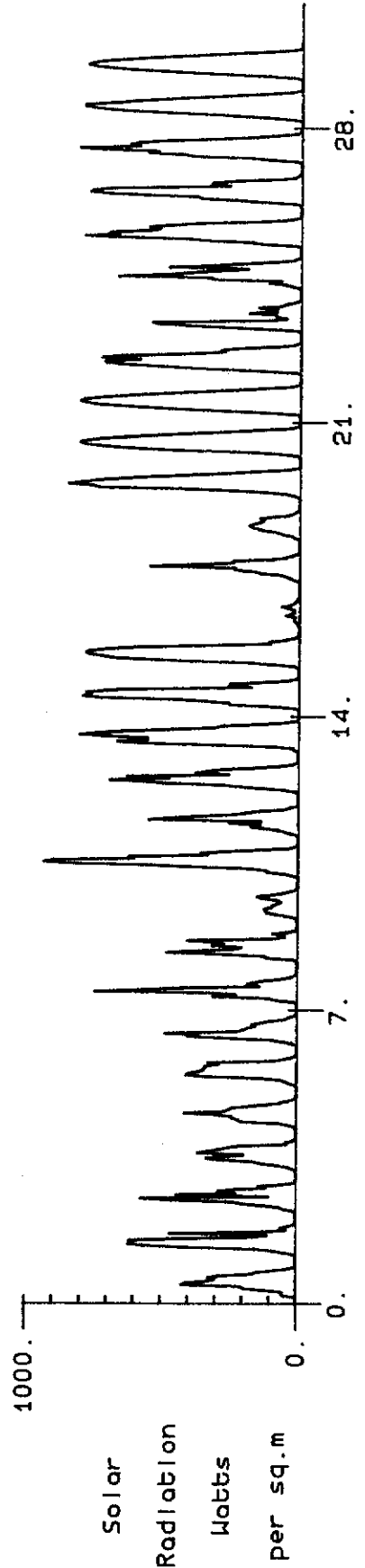
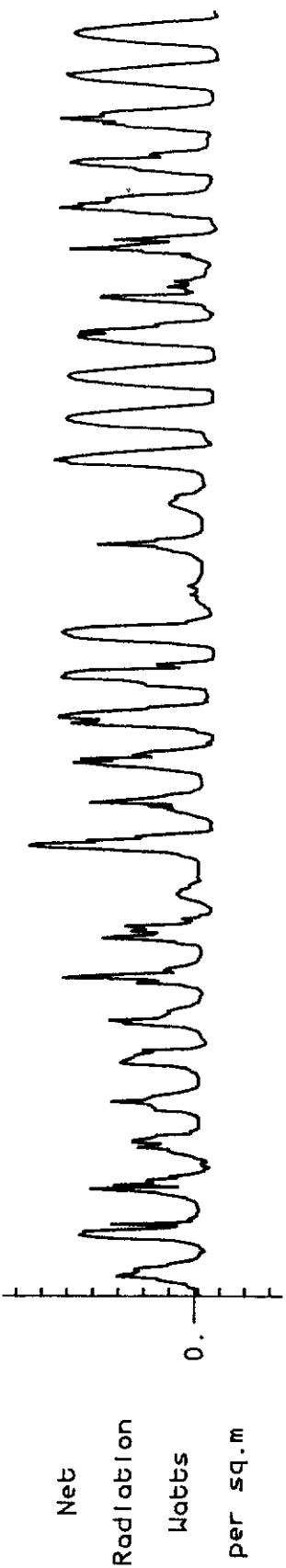
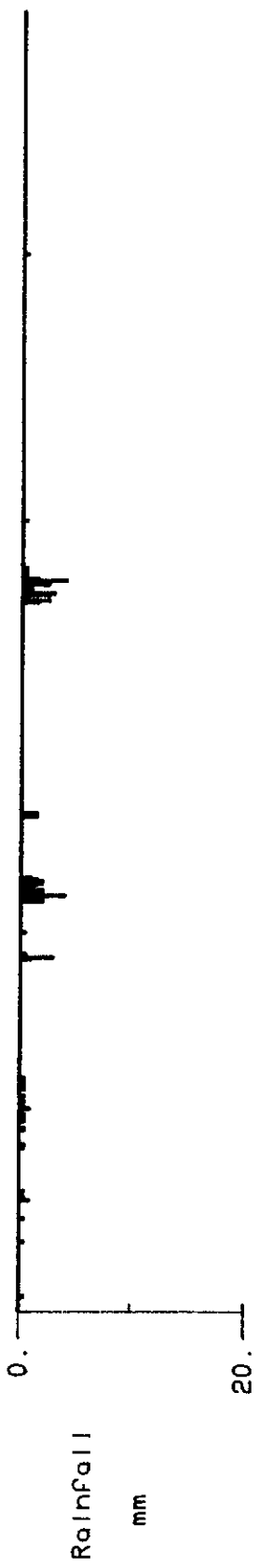


ALLT A MHARCAIDH AWS DATA
MAY86



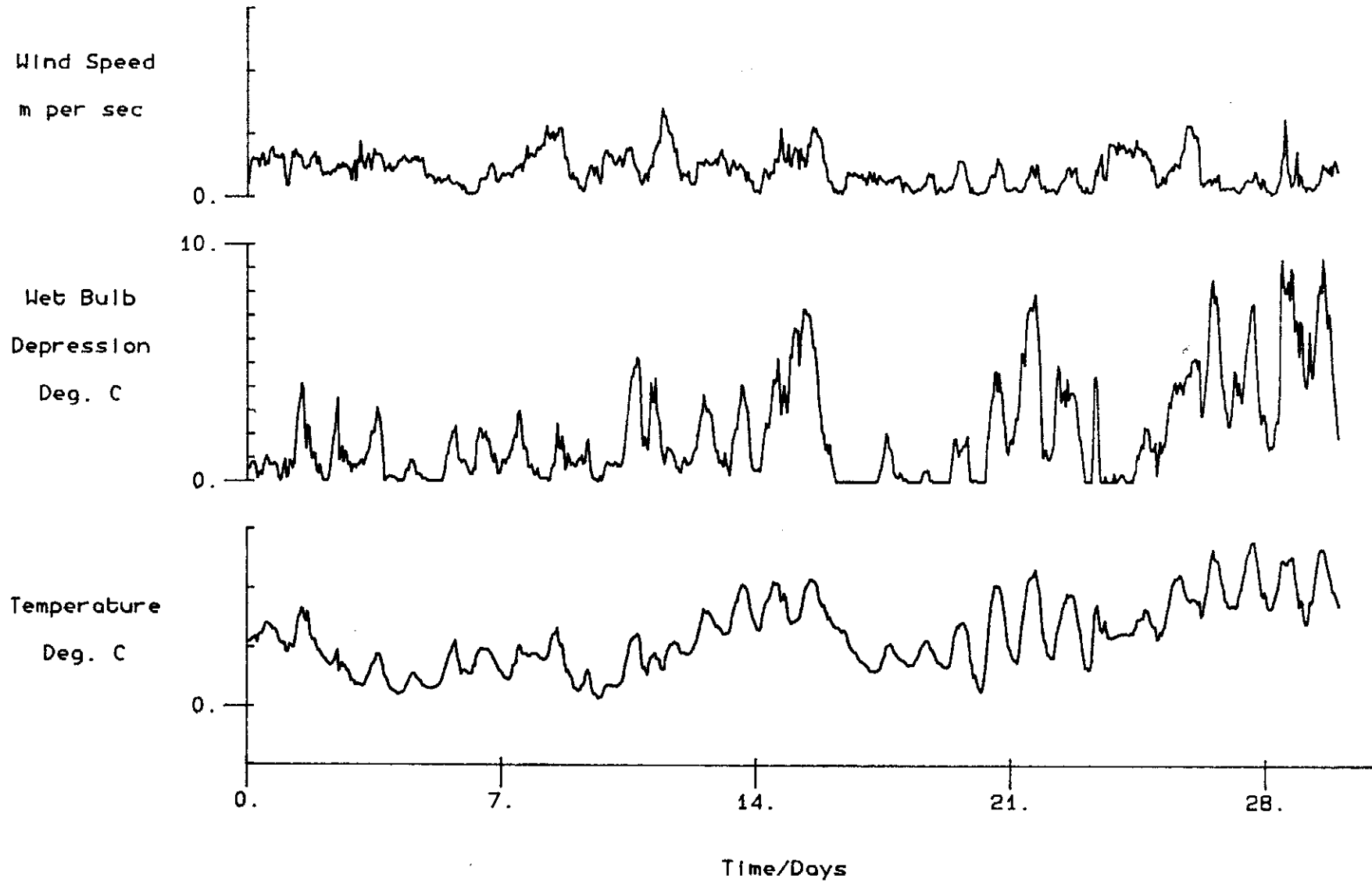
Time/Days

ALLT A MHARCAIDH AWS DATA
JUN86



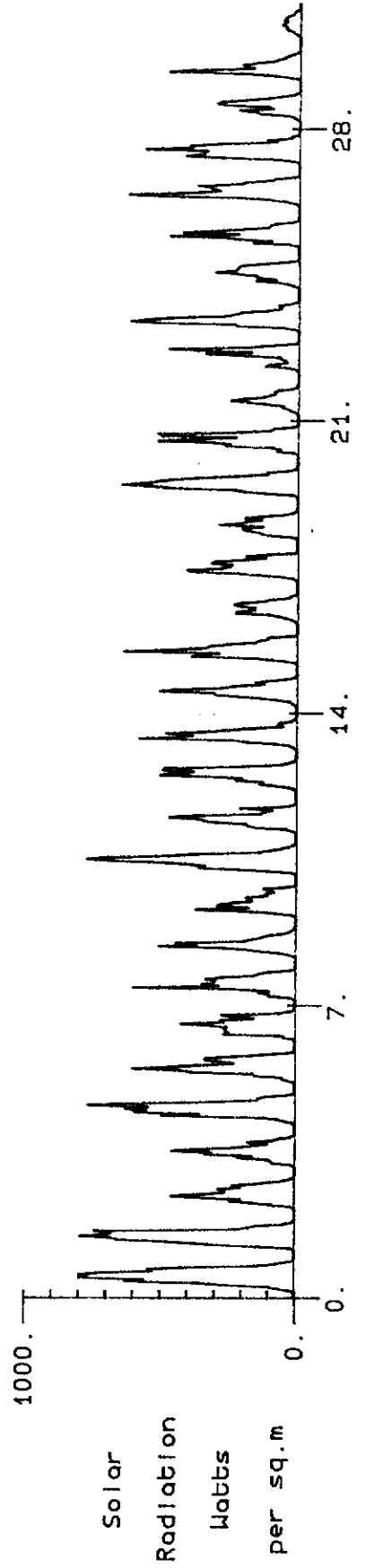
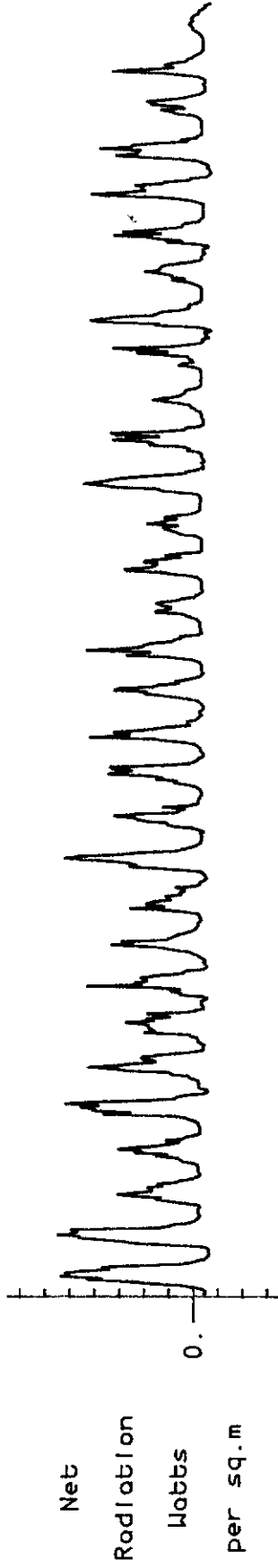
ALLT A MHARCAIDH AWS DATA

JUN86



ALLT A MHARCAIDH AWS DATA

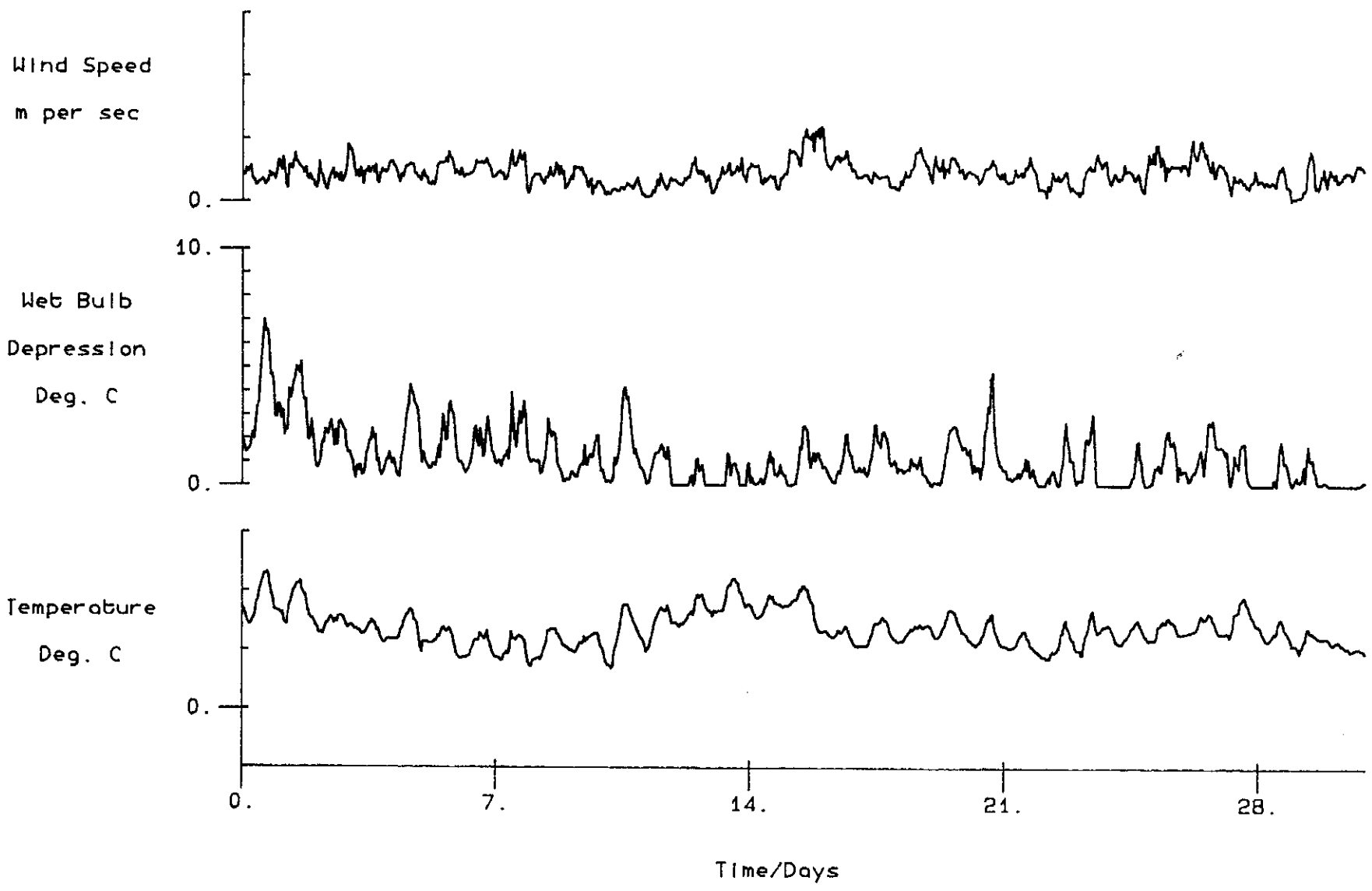
JUL86



Time/Days

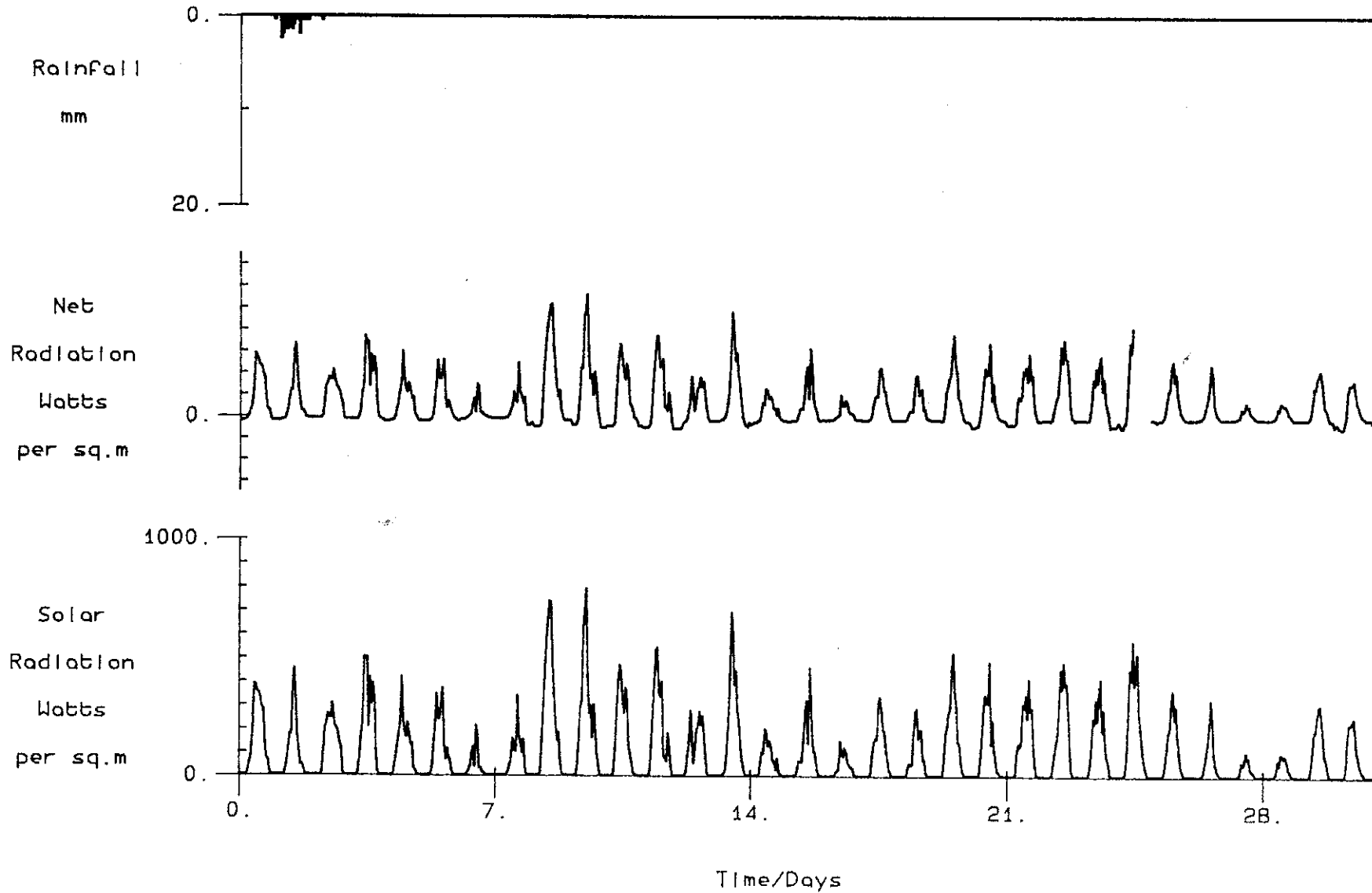
ALLT A MHARCAIDH AWS DATA

JUL86



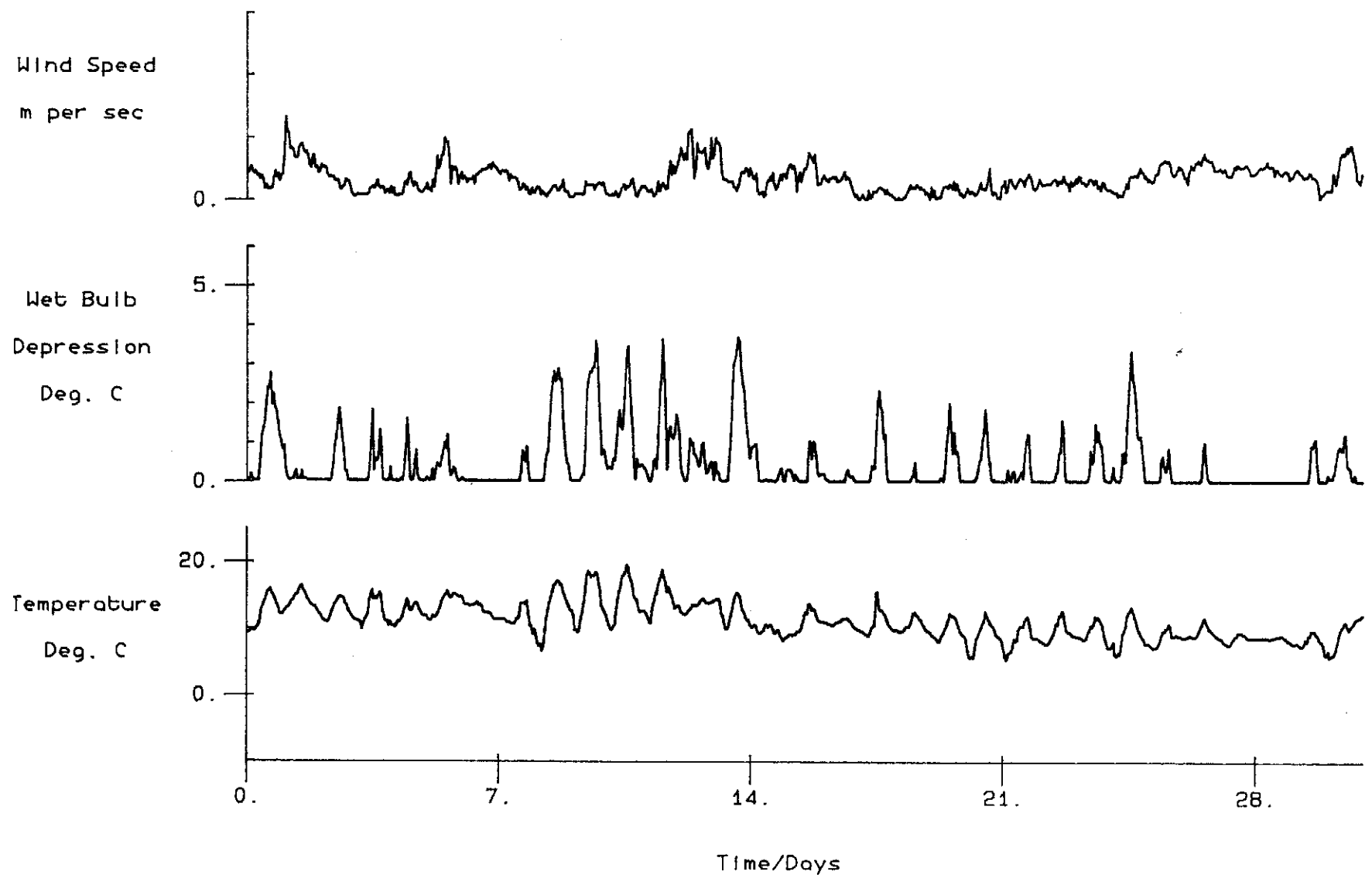
ALLT A MHARCAIDH AWS DATA

AUG86



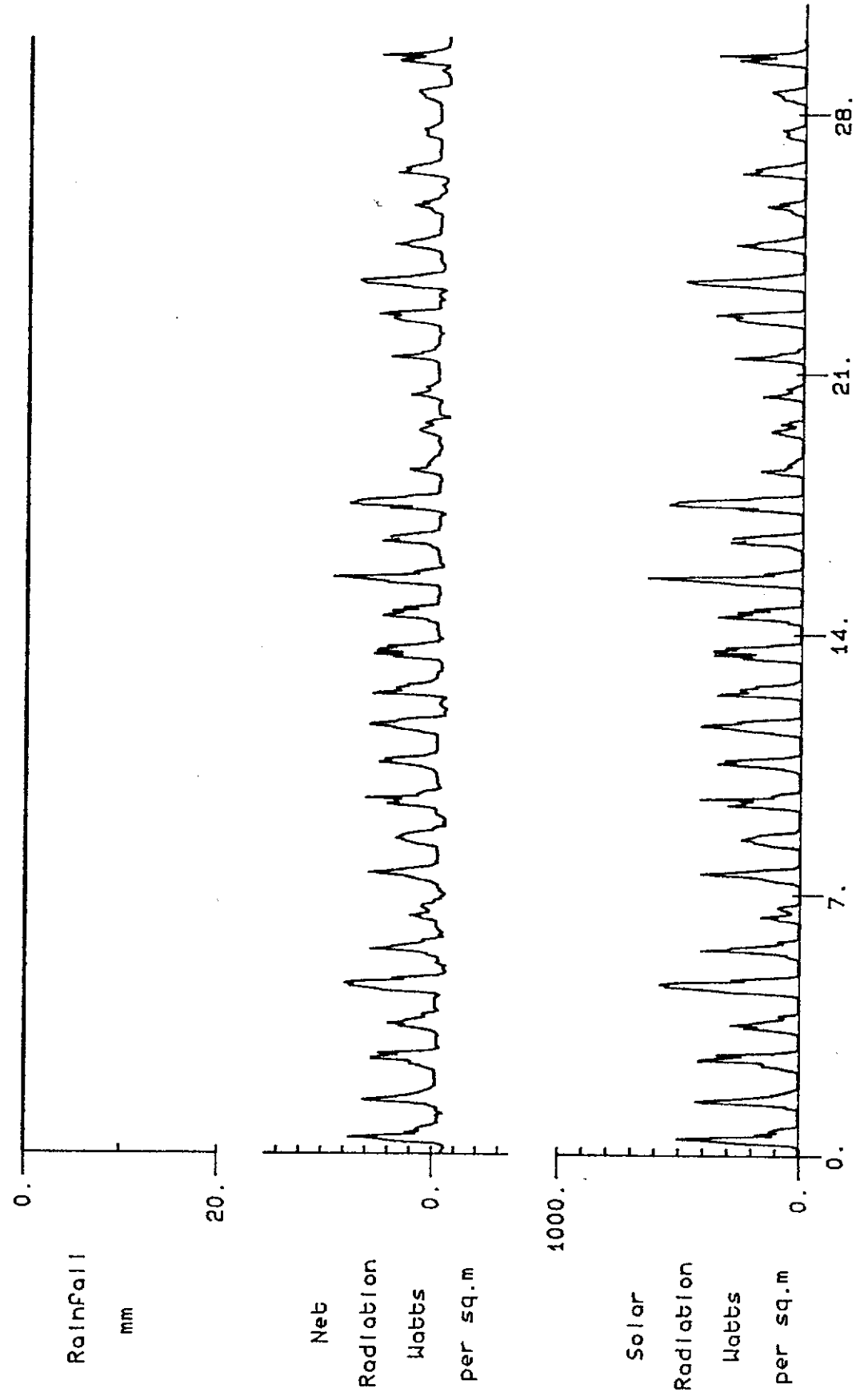
ALLT A MHARCAIDH AWS DATA

AUG86



ALLT A MHARCAIDH AWS DATA

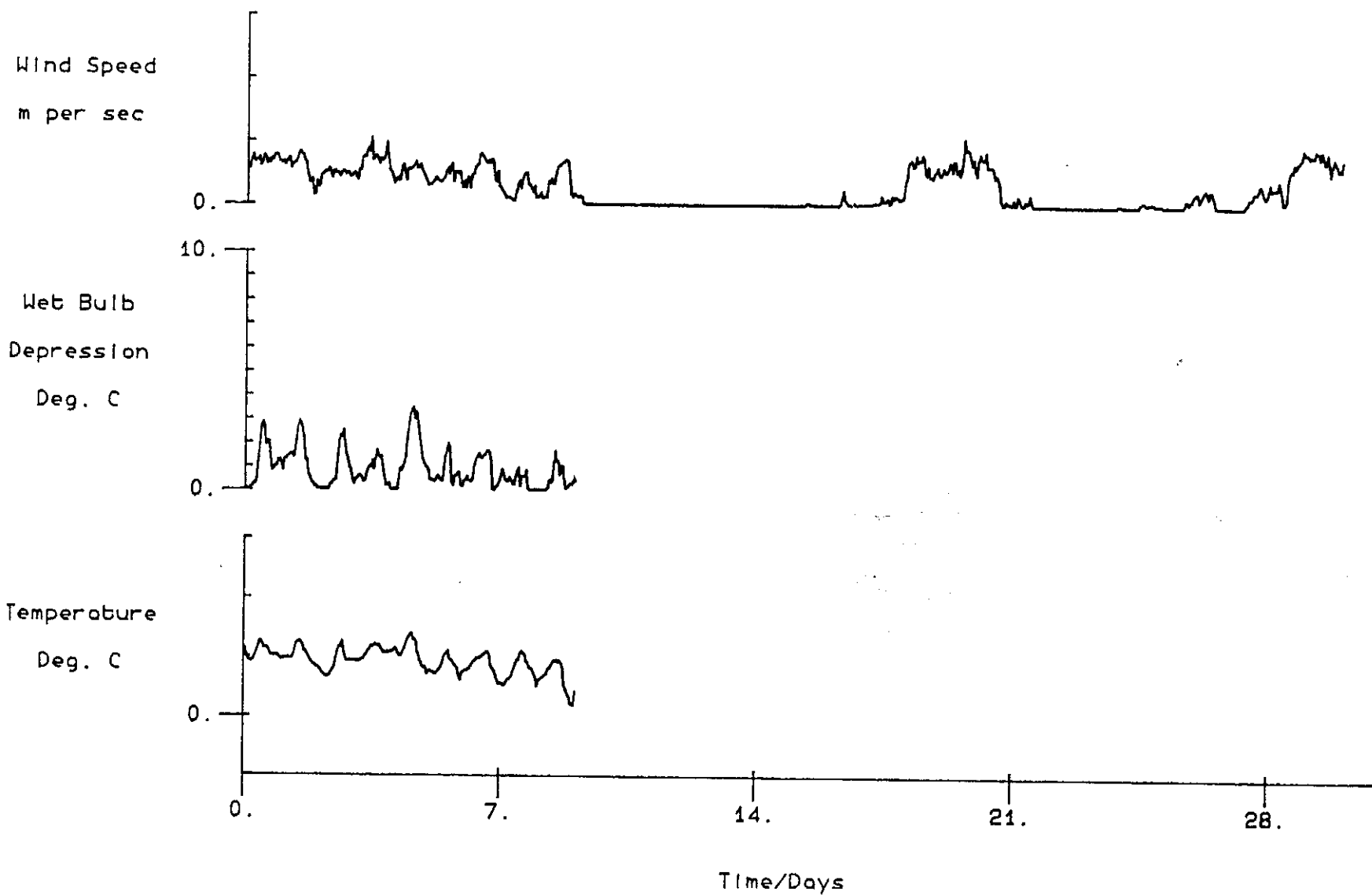
SEP86



Time/Days

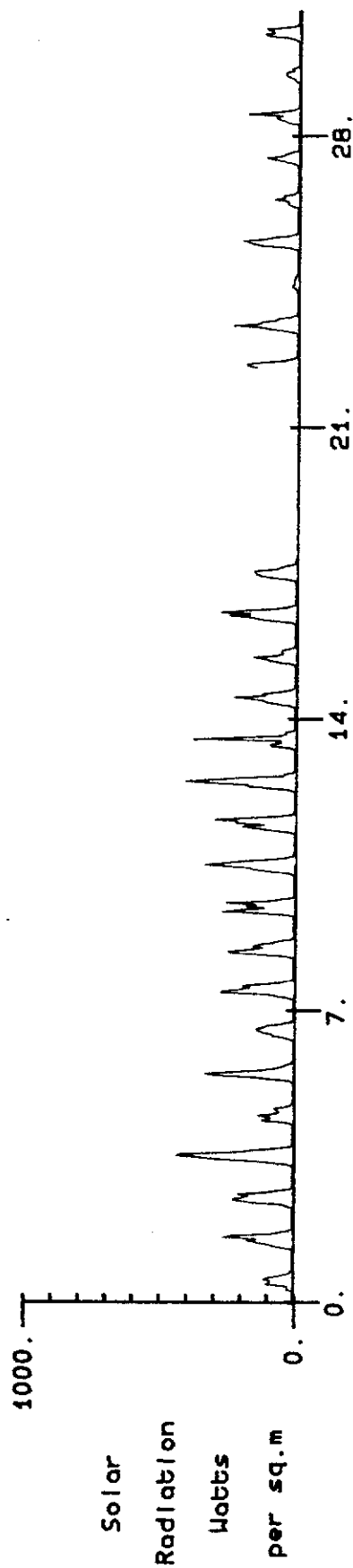
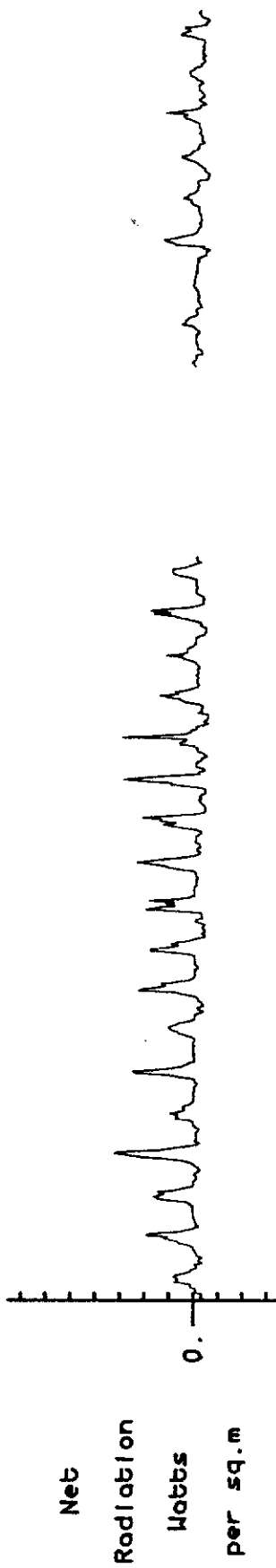
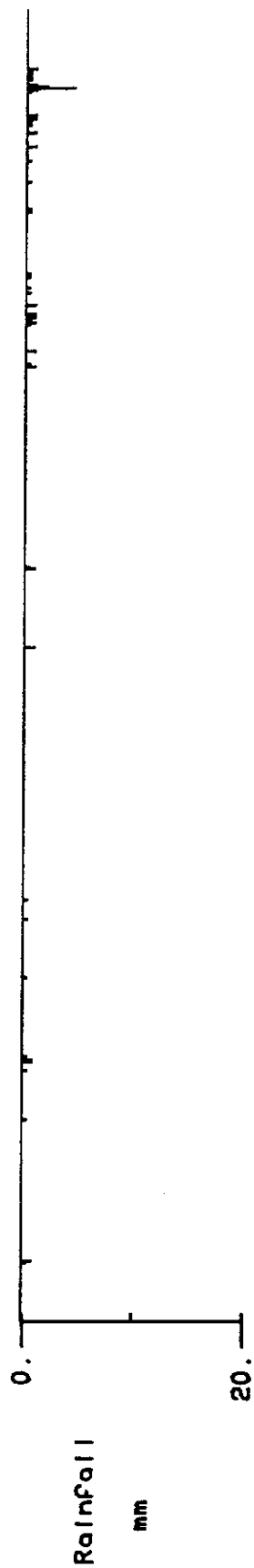
ALLT A MHARCAIDH AWS DATA

SEP86



ALLT A MHARCAIDH AWS DATA

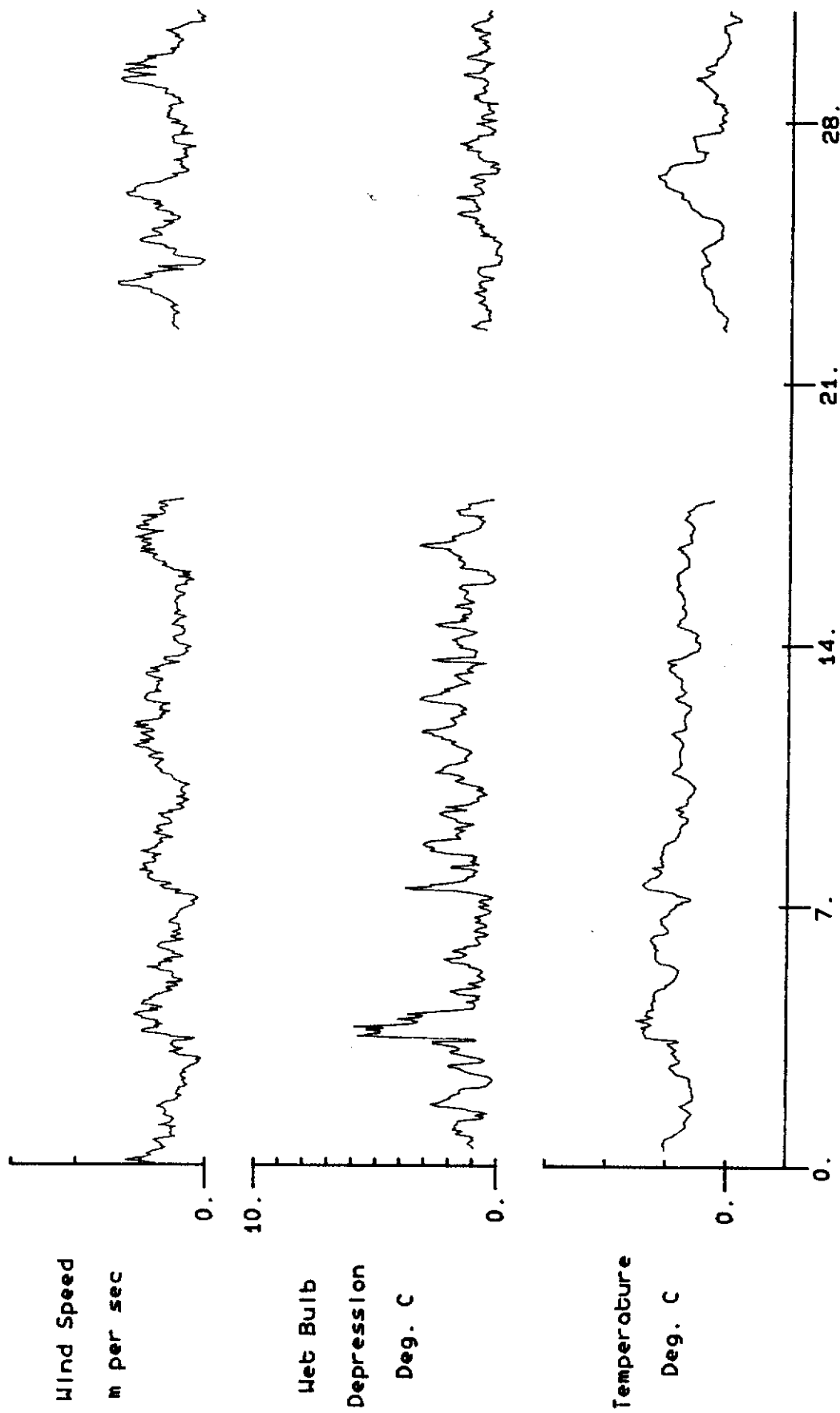
OCT86



Time/Days

ALLT A MHARCAIDH AWS DATA

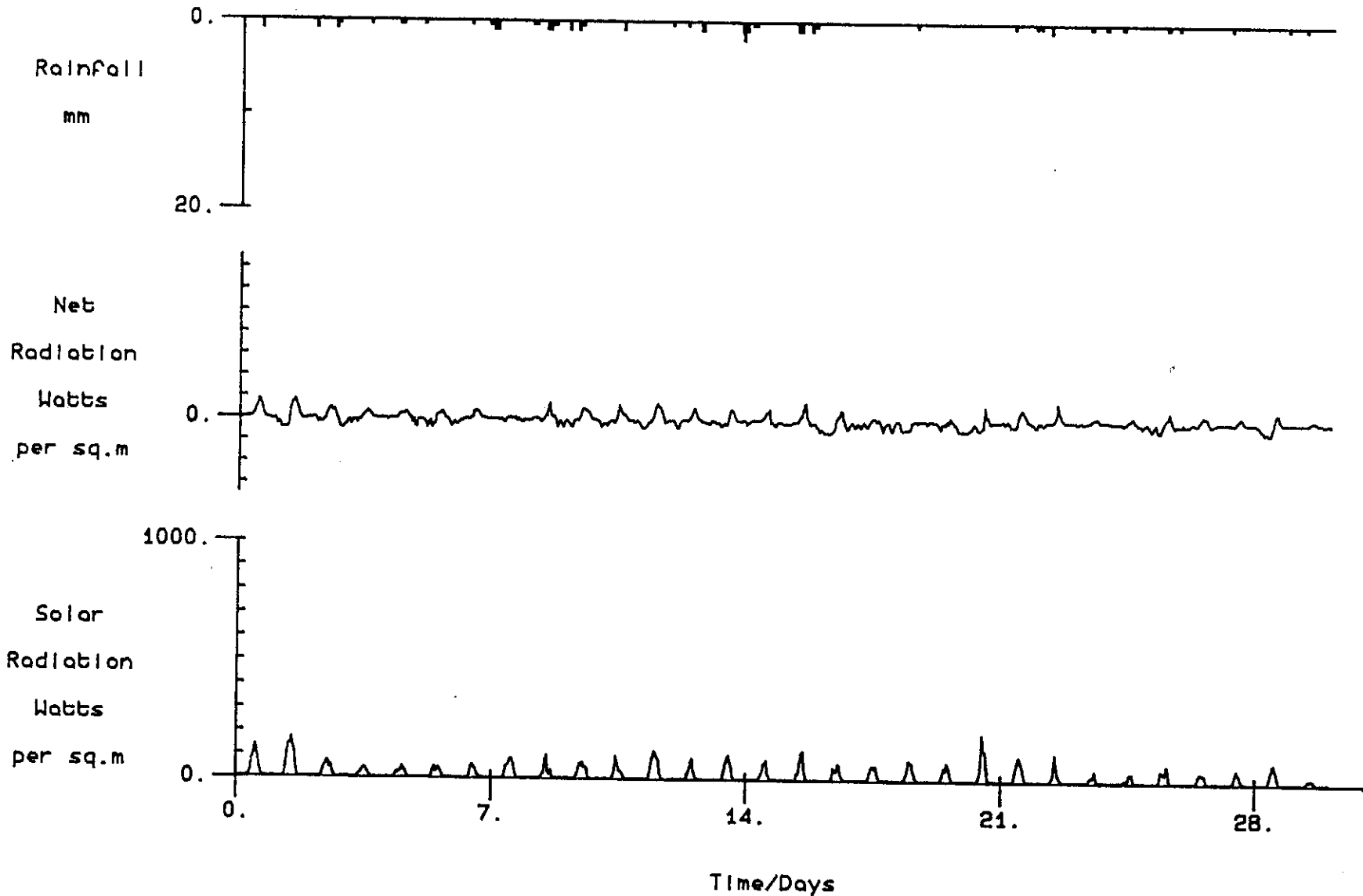
OCT86



Time/Days

ALLT A MHARCAIDH AWS DATA

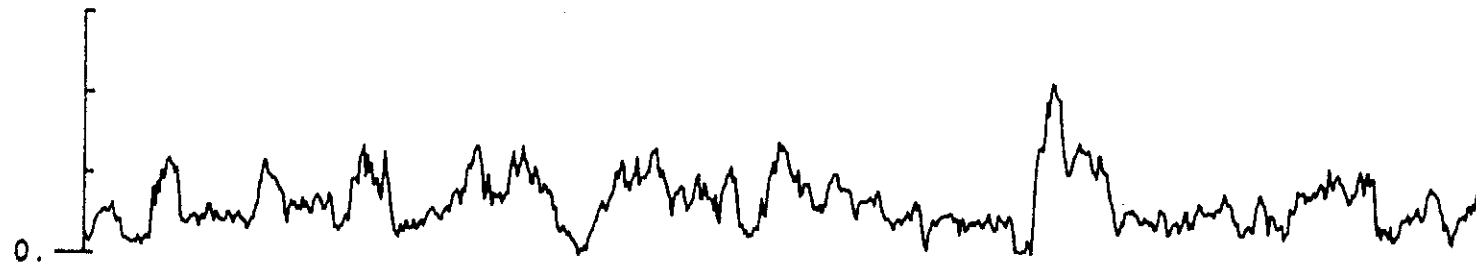
NOV86



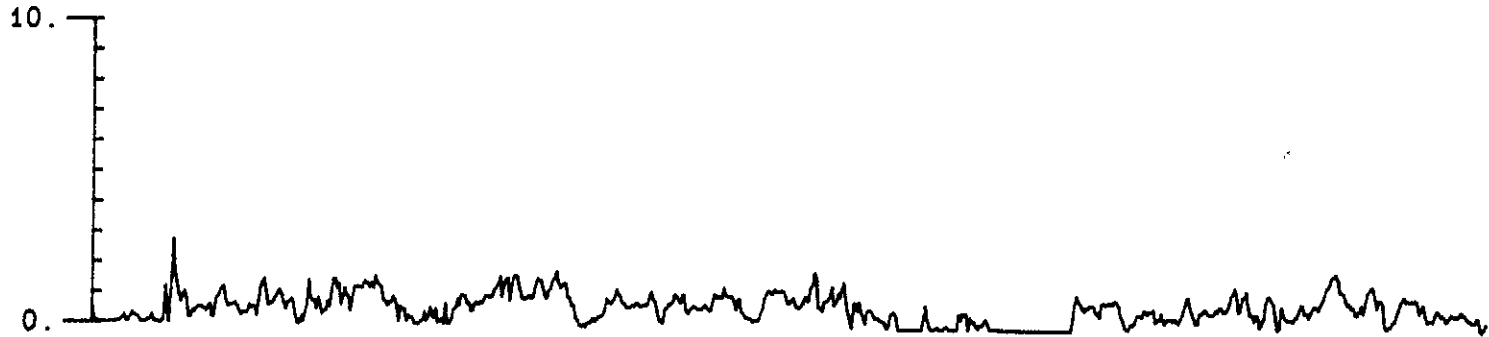
ALLT A MHARCAIDH AWS DATA

NOV86

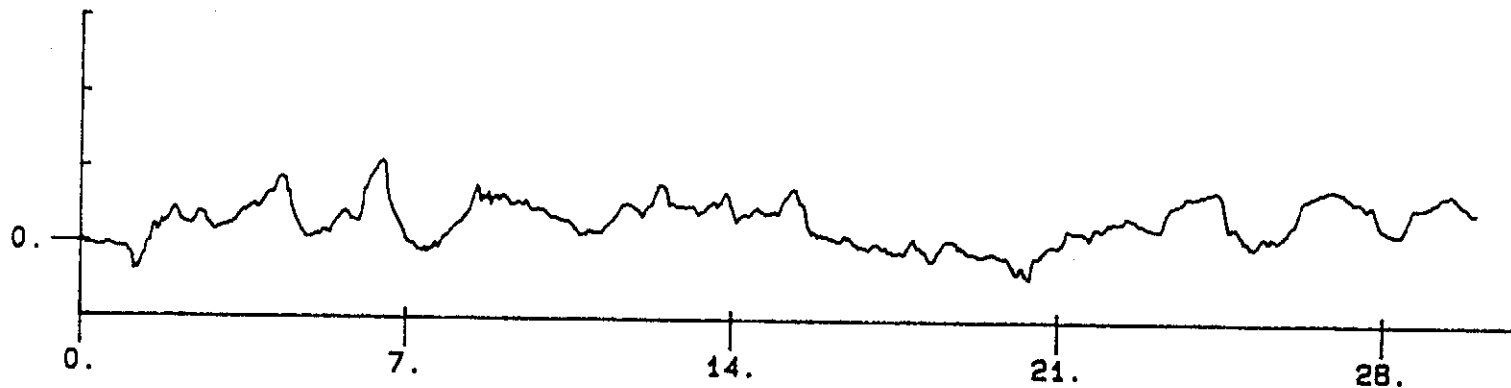
Wind Speed
m per sec



Wet Bulb
Depression
Deg. C



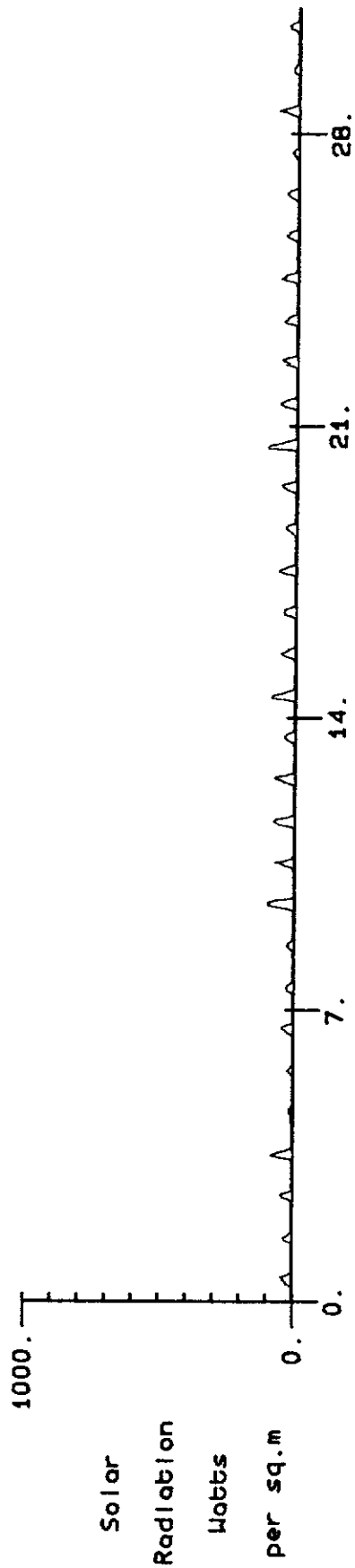
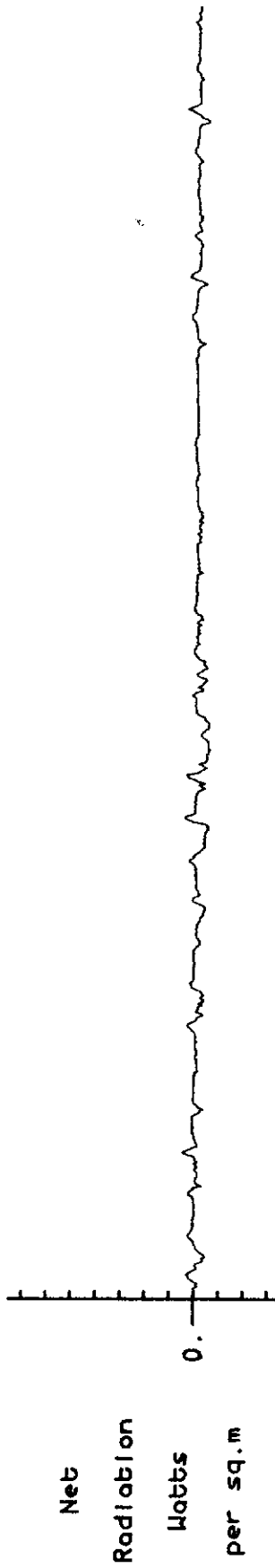
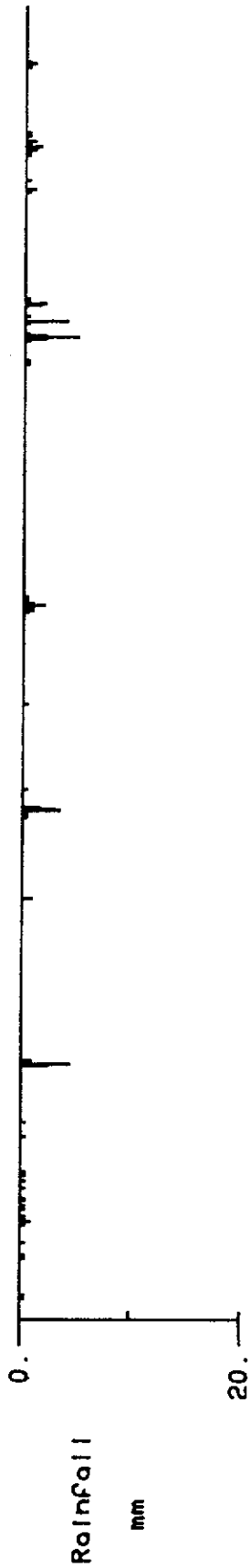
Temperature
Deg. C



Time/Days

ALLT A MHARCAIDH AWS DATA

DEC86



ALLT A MHARCAIDH AWS DATA

DEC86

