PETERBOROUGH CATHEDRAL

ENVIRONMENTAL MONITORING DATA

5th APRIL TO 13th JUNE 1995.

PETERBOROUGH CATHEDRAL
ENVIRONMENTAL MONITORING
SECOND PERIOD
5th APRIL TO 13th JUNE 1995

Monitoring has been undertaken to establish the environmental conditions within the cathedral so that an assessment can be made as to whether the medieval painted ceiling is being adversely affected by the heating system.

Temperature and humidity probes, and surface temperature sensors, have been installed in the main body of the cathedral and in various voids above the painted ceiling. Conditions are also being monitored externally to enable an estimate to be made whether extremes of temperature affect the internal readings. For this monitoring period extra sensors have been installed internally and externally to gain a greater understanding of the heat and air flow patterns within the building.

EXTERNAL CONDITIONS.

During this monitoring period a "black ball" sensor was installed to record radiant temperatures. These varied between -2°C and 40°C whilst the shade temperatures ranged from zero°C to 30°C. The relative humidity fluctuated from 100% to 30%. Graph 1 clearly shows the daily variations of temperature and humidity and indicates a general levelling in temperature towards the end of the period.

INTERNAL CONDITIONS.

Main Body of Building.

Temperature and humidity sensors are installed at three levels in the nave to determine the degree of "layering" of the heated air. Additional sensors are fixed to the underside of the painted ceiling to measure surface and air temperatures and relative humidity.

Graph 6 shows the temperatures on either side of the painted ceiling as well as the dew point temperatures. It shows that, as the surface and dewpoint temperatures are well separated, there was no likelihood of surface condensation on the ceiling during this monitoring period. Graph 7 shows the vapour pressure either side of the ceiling and it can be seen that moisture is moving in either direction. As the ceiling is of a relatively light construction, the moisture should pass through with little effect on the wood.

The sensors in a vertical stack in the main body of the cathedral indicate a very stable environment. Graph 8 shows the three internal readings plus the external, it shows clearly that whilst the external conditions are varying by a very wide margin, the internal readings are "buffered" by the building fabric.

Graph 9 comprises the readings from the internal sensors only, it can be seen that three temperature graphs are almost indentical giving, as for the previous period, an almost total lack of temperature gradient. This is probably helped by there being a draught lobby preventing ingress of air every time the main doors are opened. Graph 10 is an expanded portion of the data indicating the stability of the internal environment whist the external conditions are fluctuating over a wide range.

Roof Void.

Additional sensors were installed to give high level temperature and humidity and also the temperature of the roof boarding on the south side of the building. Graph 1 shows the relationship between the three temperatures for the complete monitoring period. Graphs 2 and 3 are an expanded portion of the data and have the external ambient temperature included. Daily variations of temperature can be clearly seen and it can also be seen how the roof boarding follows the external temperature. The internal air temperature shows distinct daily variations but these are smoothed out showing how the building fabric helps remove extremes of "peaks and troughs".

Graph 4 shows the dew point and surface temperatures of the roof boarding, as there is no clear crossover point it is very unlikely that any surface condensation formed on the inside of the roof during this monitoring period. Graph 5 shows the internal and external vapour pressures. The graph clearly indicates that the trend of moisture movement is from outside to inside but can move in either direction depending on the temperature and humidity at any given time. The moisture movement through the roof structure caused by the vapour pressure difference will be absolutely minimal due to the vapour resistance of the bitumen felt under the roof tiles.

Unlike the previous monitoring period when the underside of the painted ceiling was always warmer than the topside, the temperature varied on either side of the ceiling. This effect can be seen in Graph 6 where the topside temperature is obviously being affected by the external conditions.

CONCLUSIONS.

From the results obtained during this monitoring period it is very unlikely that an environmental situation would have occurred which was detrimental to the painted ceiling.

Visual inspection of the ceiling should continue to check whether the condition of the wooden panels has stabilised or if the fastenings are continuing to become dislodged.

K Waterman
7/8/95

The advice which this report contains refers only to works of a building services nature and it should be borne in mind that there may be conservation or other issues on which the Architects and Inspectors of English Heritage may wish to comment.

This advice does not imply listed building or scheduled monument consent, neither does it imply that grant aid is either applicable or available for the work suggested.

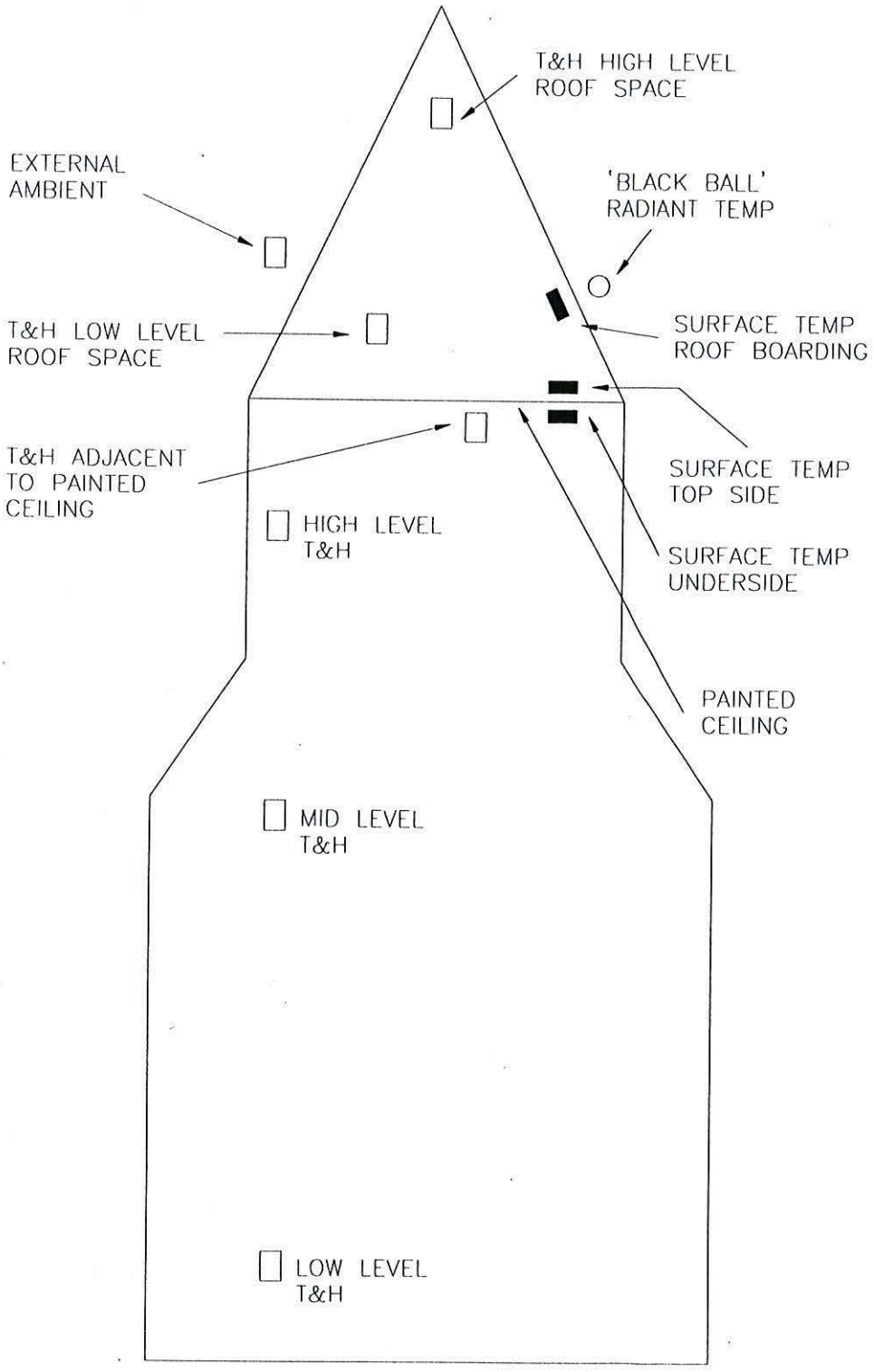
No legal liability will be accepted by English Heritage in connection with this advice, and the owner of the building/structure is reminded of the importance of taking his/her own professional advice if he/she wishes.

The execution of any works suggested in this report must be supervised by a competent person.

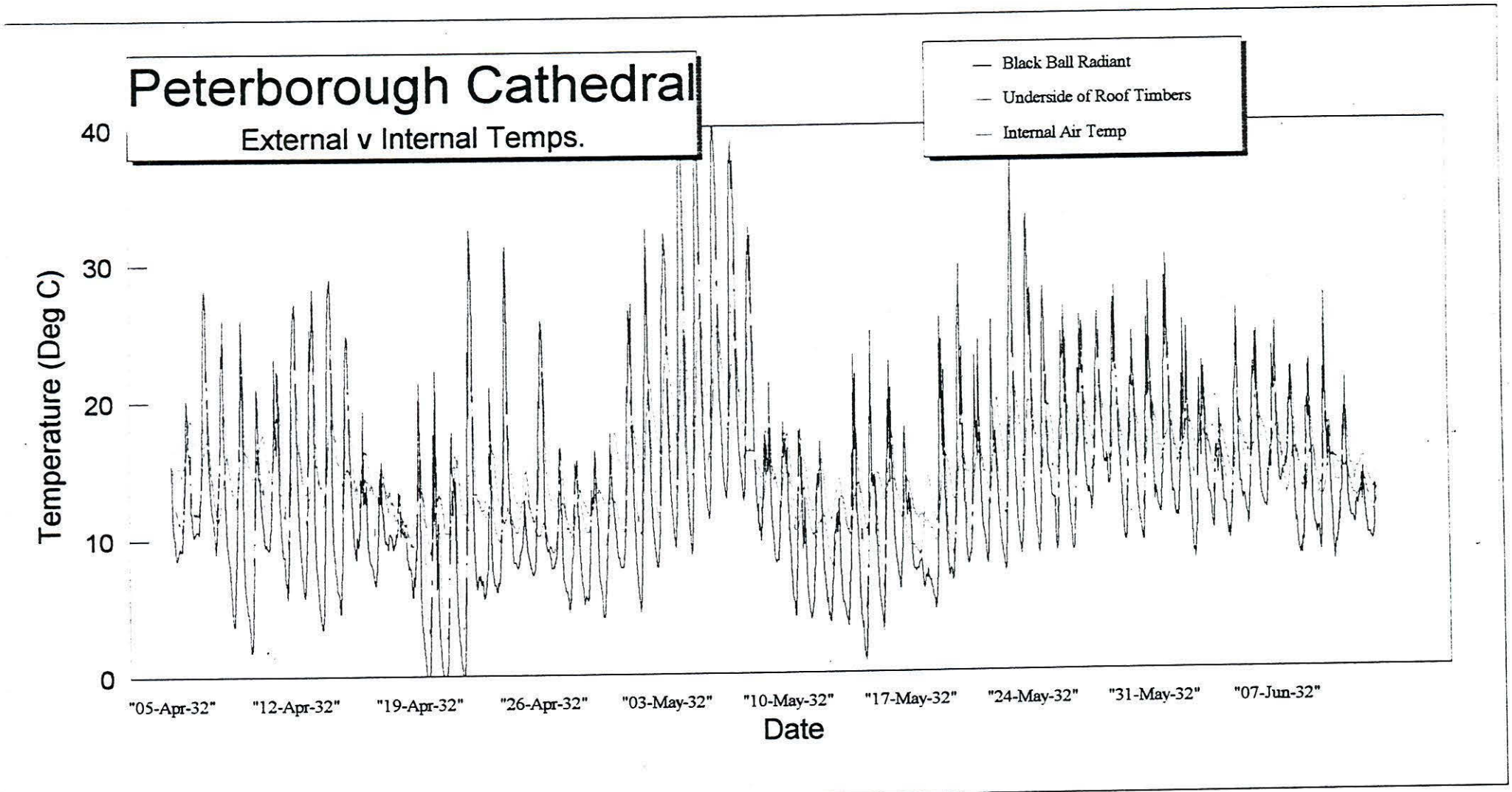
This report refers only to those parts of the building/structure inspected and unless specifically stated, it does not refer to inaccessible parts of the structure. The report is on the current condition of the installation and due care and attention to inspection and maintenance is vital to avoid further deterioration.

PETERBOROUGH CATHEDRAL

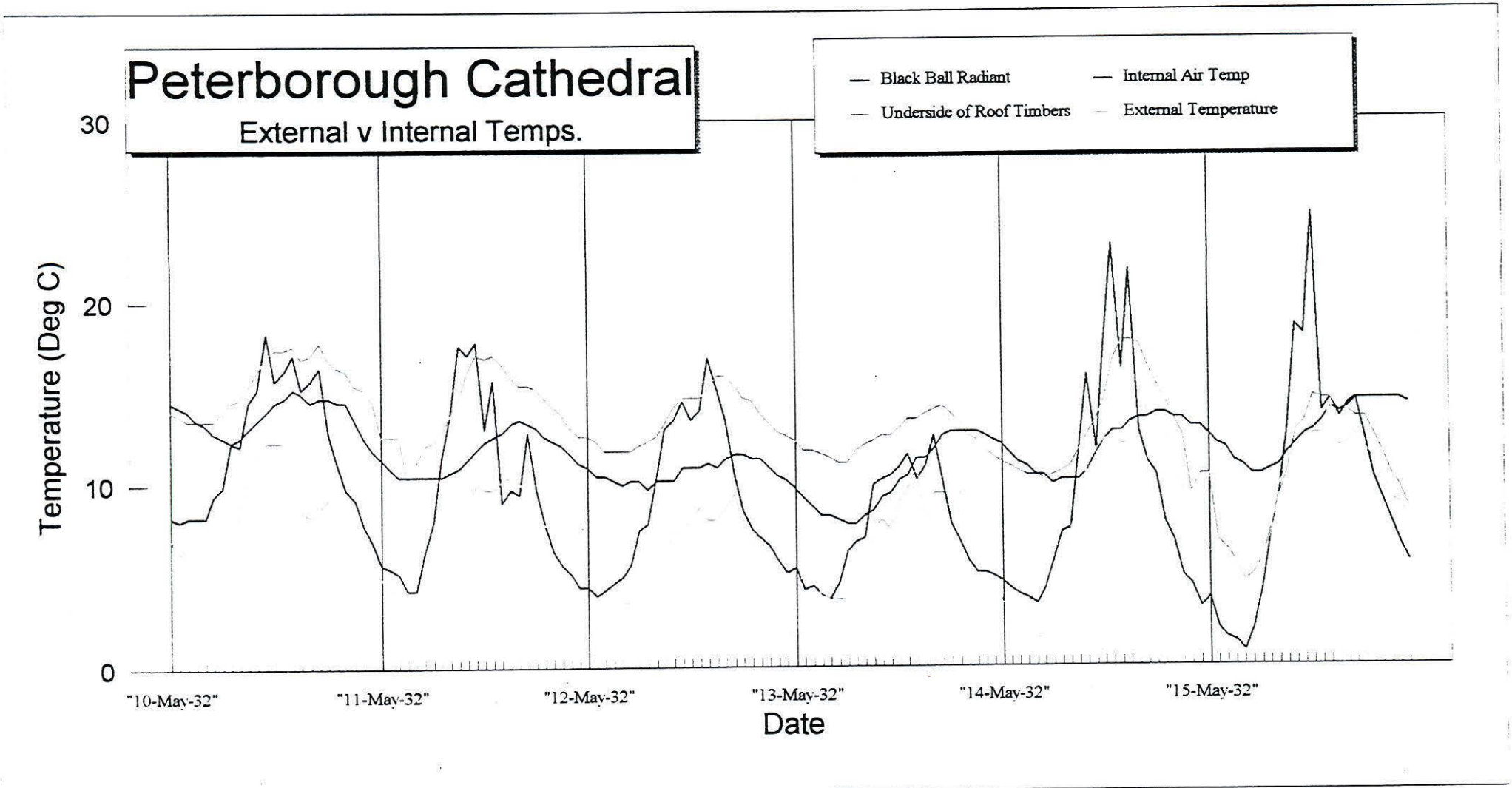
DESIGNATION OF SENSORS



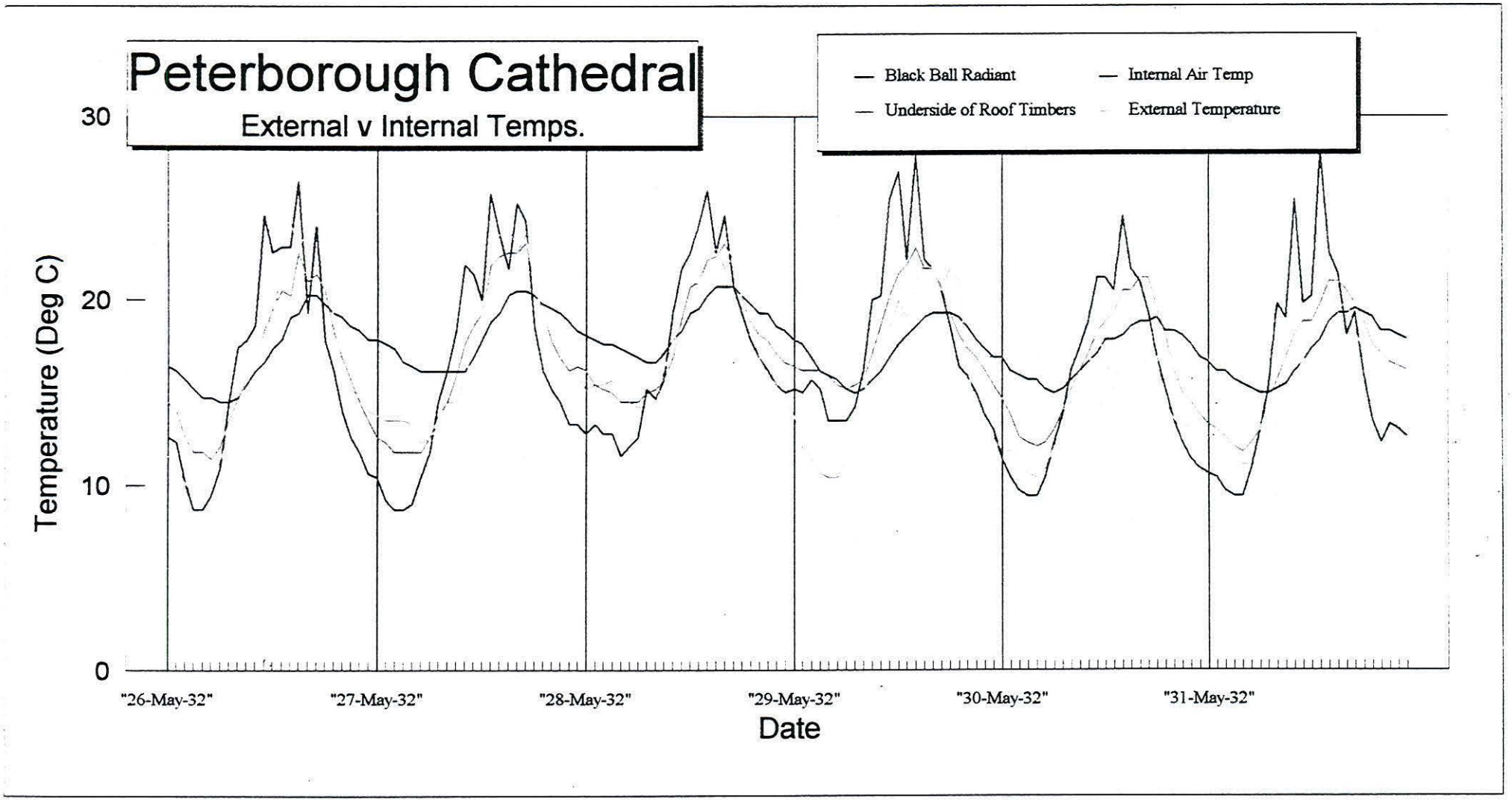
GRAPH 1.


Peterborough Cathedral
External v Internal Temps.
Black Ball Radiant
Underside of Roof Timbers
Internal Air Temp
Temperature (Deg C)
40
30
20
10
0
"05-Apr-32"
"12-Apr-32"
"19-Apr-32"
"26-Apr-32"
"03-May-32"
"10-May-32"
"17-May-32"
"24-May-32"
"31-May-32"
"07-Jun-32"
Date

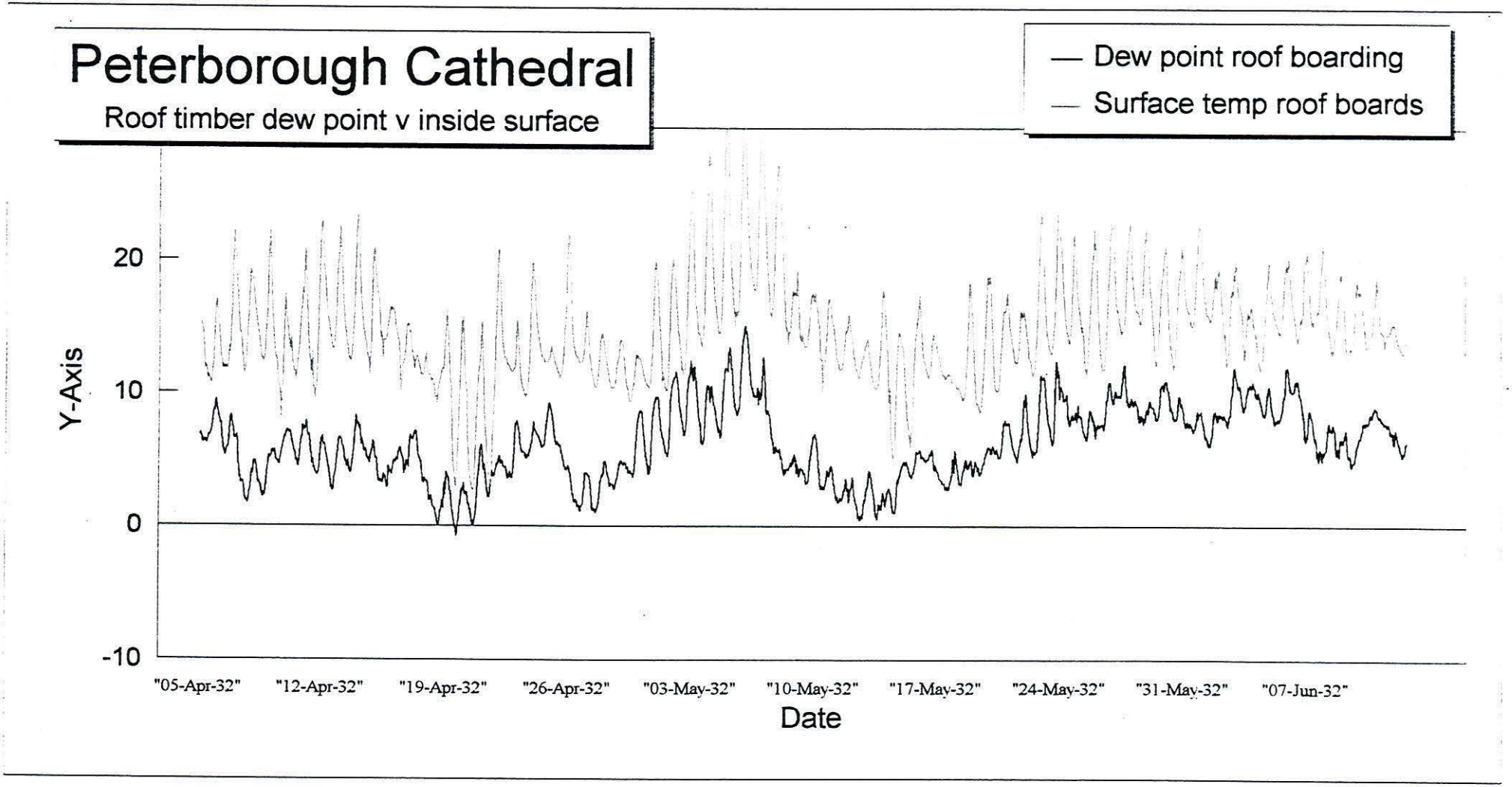
GRAPH 2.


Peterborough Cathedral
External v Internal Temps.
Black Ball Radiant
Internal Air Temp
Underside of Roof Timbers
External Temperature
Temperature (Deg C)
30
20
10
0
"10-May-32"
"11-May-32"
"12-May-32"
"13-May-32"
"14-May-32"
"15-May-32"
Date

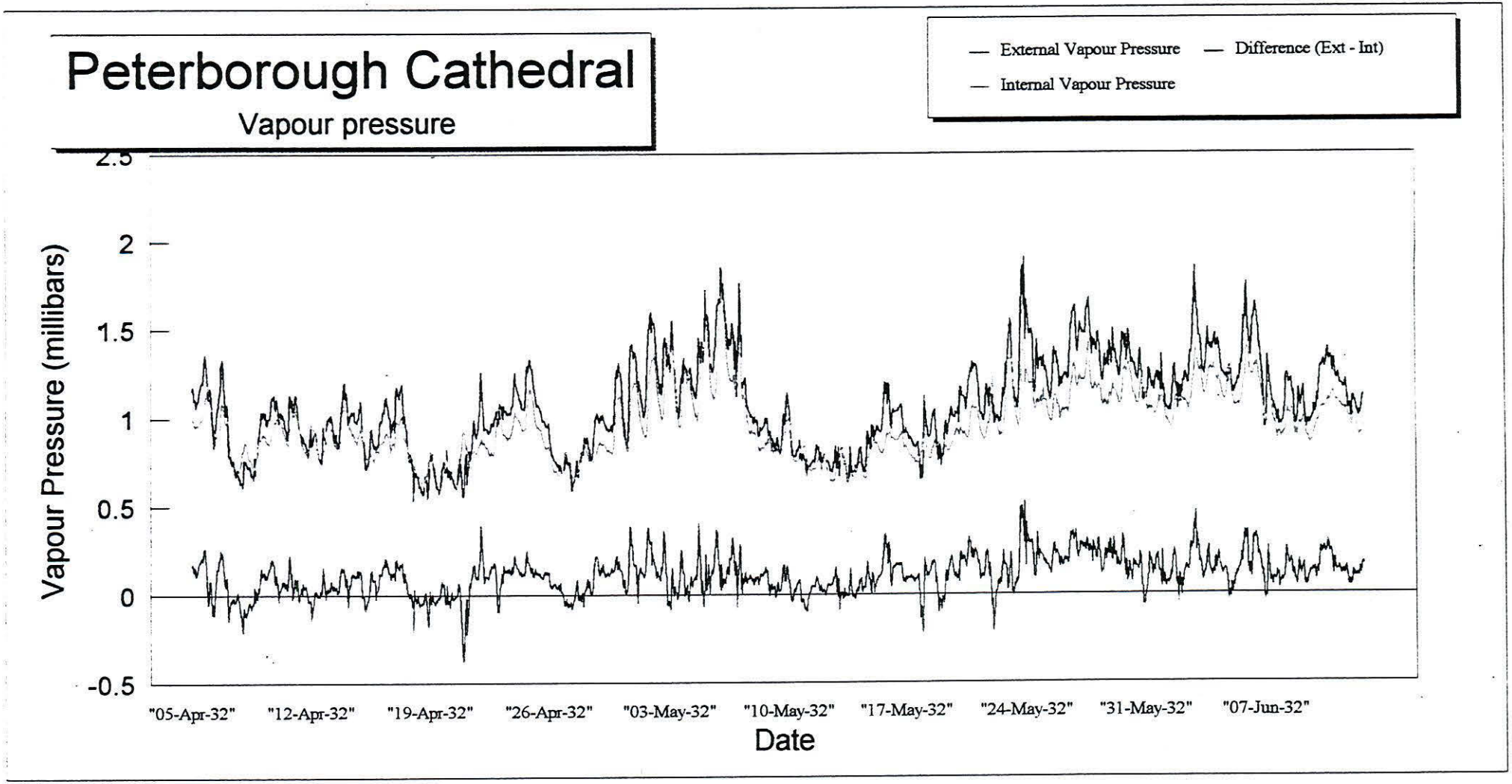
GRAPH 3.


Peterborough Cathedral
External v Internal Temps.
Black Ball Radiant
Internal Air Temp
Underside of Roof Timbers
External Temperature
Temperature (Deg C)
30
20
10
0
"26-May-32"
"27-May-32"
"28-May-32"
"29-May-32"
"30-May-32"
"31-May-32"
Date

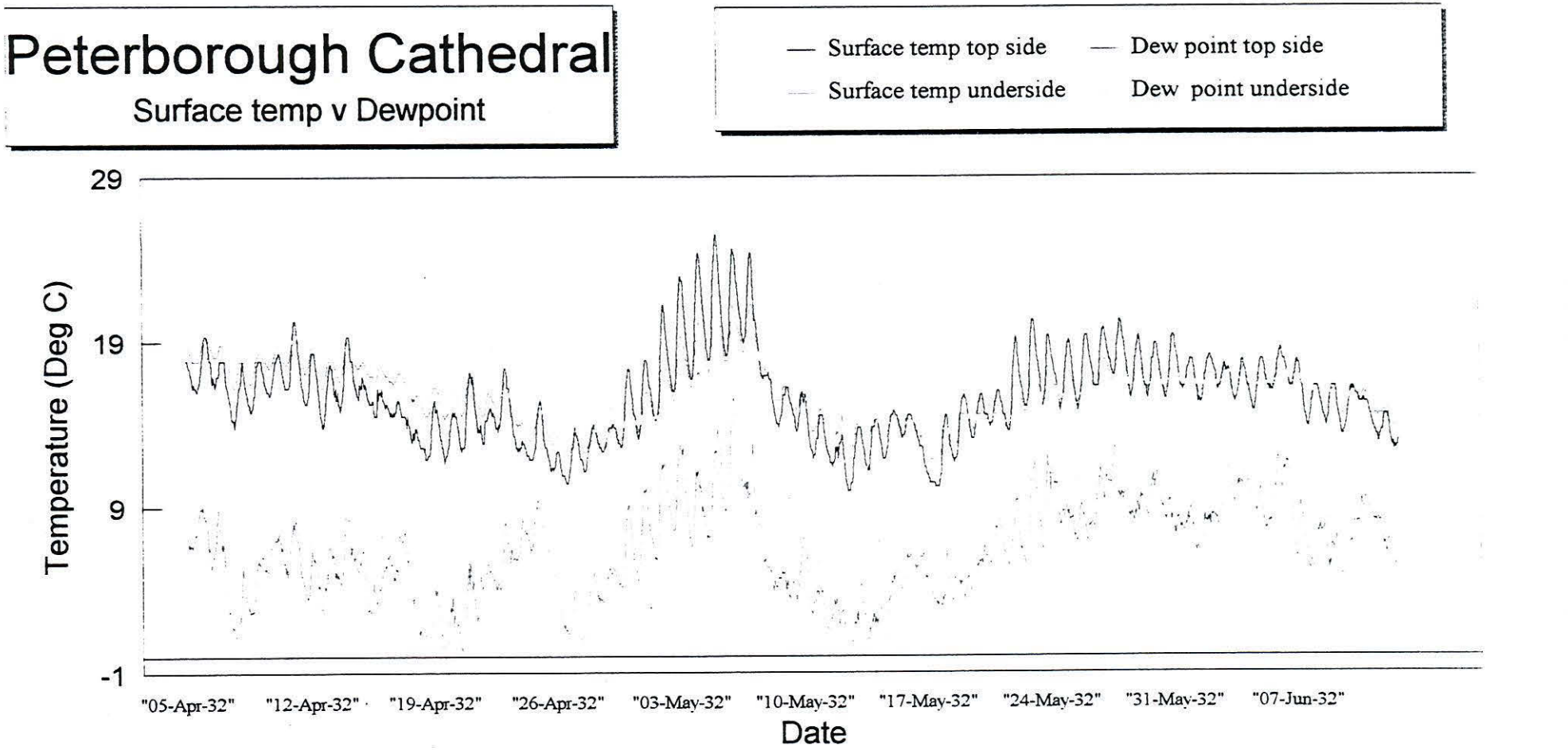
GRAPH 4.


Peterborough Cathedral
Roof timber dew point v inside surface
Dew point roof boarding
Surface temp roof boards
Y-Axis
20
10
0
-10
"05-Apr-32"
"12-Apr-32"
"19-Apr-32"
"26-Apr-32"
"03-May-32"
"10-May-32"
"17-May-32"
"24-May-32"
"31-May-32"
"07-Jun-32"
Date

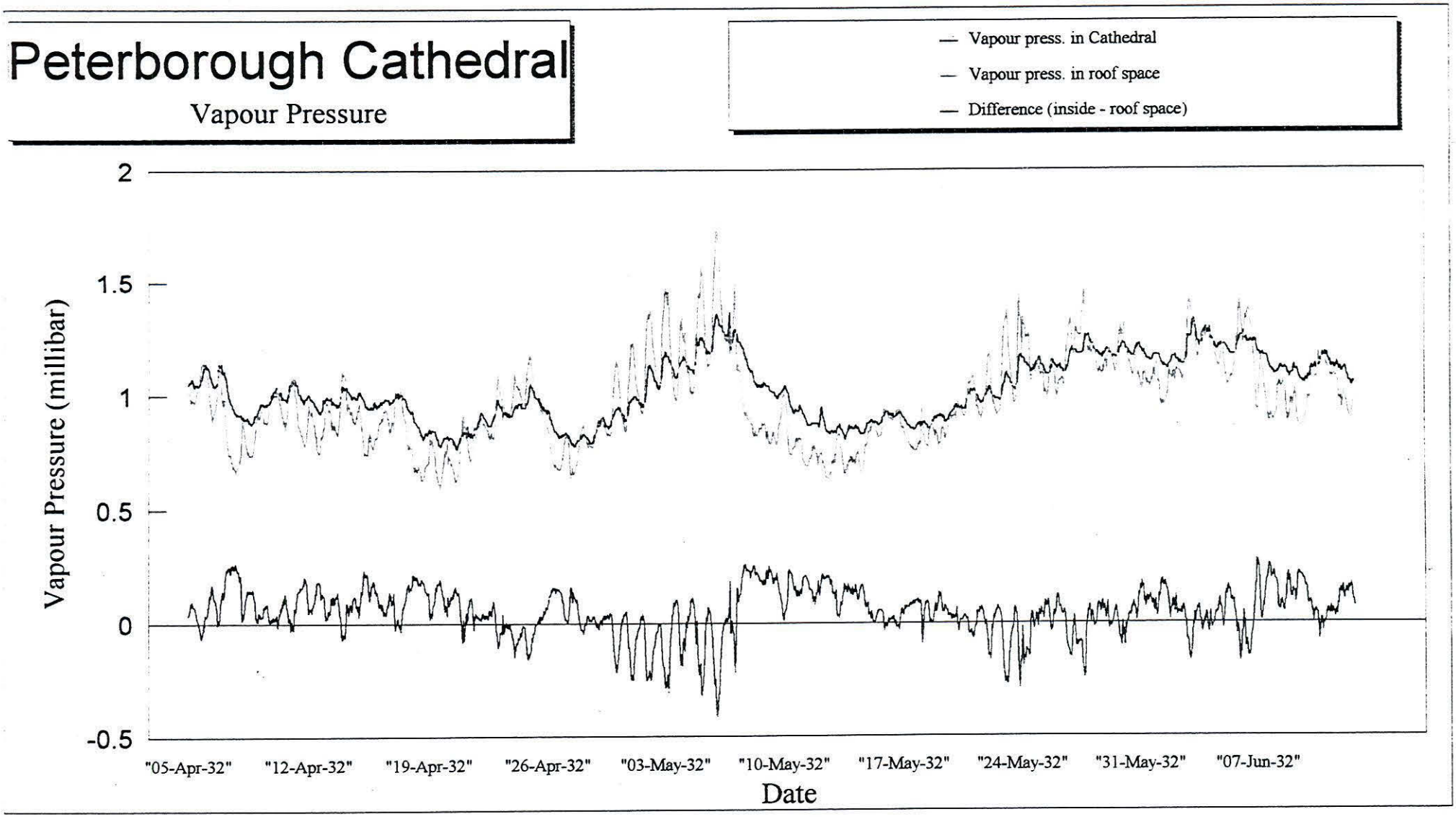
GRAPH 5.


Peterborough Cathedral
Vapour pressure
External Vapour Pressure
Difference (Ext - Int)
Internal Vapour Pressure
Vapour Pressure (millibars)
2.5
2
1.5
1
0.5
0
-0.5
"05-Apr-32"
"12-Apr-32"
"19-Apr-32"
"26-Apr-32"
"03-May-32"
"10-May-32"
"17-May-32"
"24-May-32"
"31-May-32"
"07-Jun-32"
Date

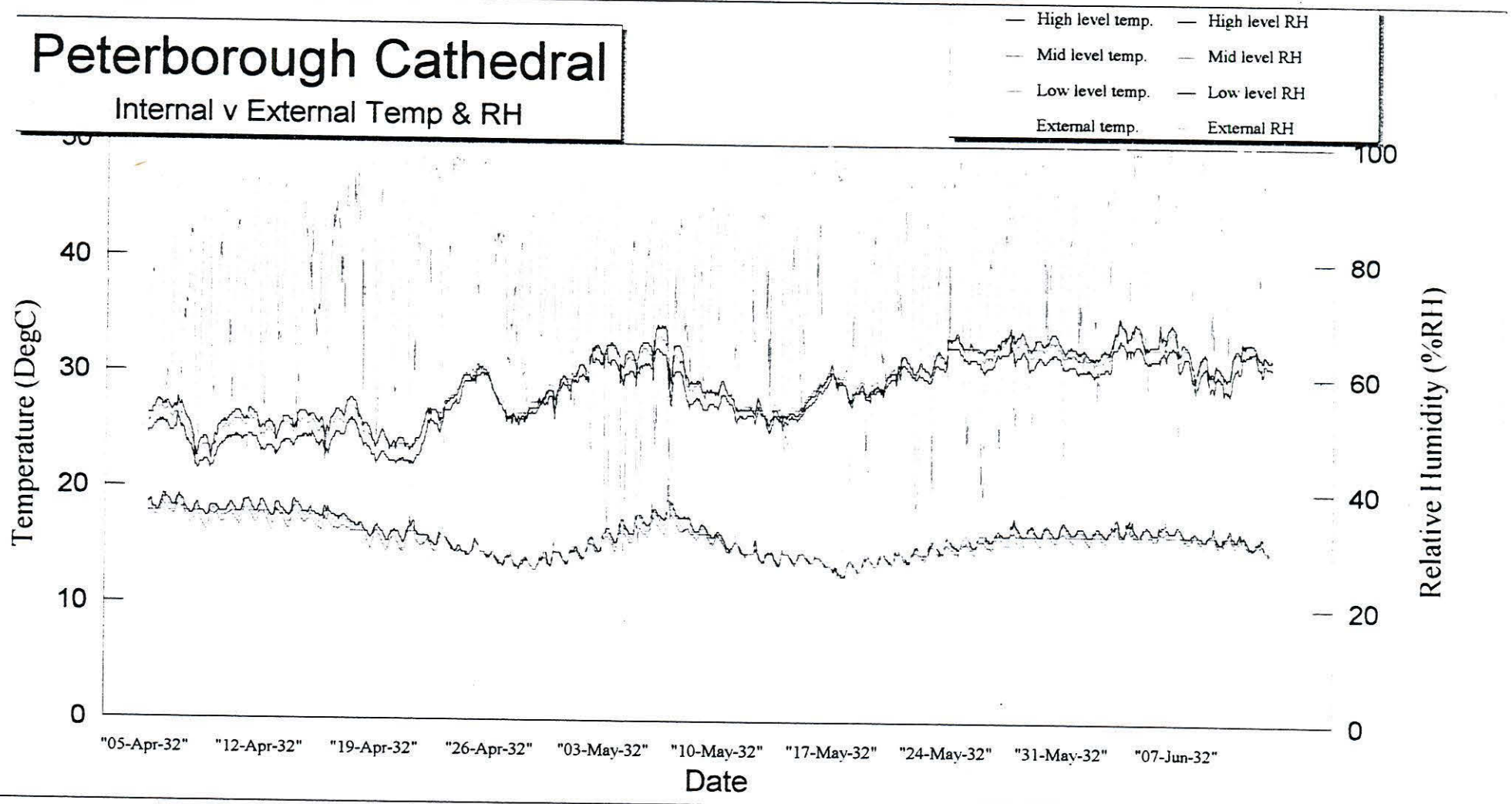
GRAPH 6.


Peterborough Cathedral
Surface temp v Dewpoint
Surface temp top side
Dew point top side
Surface temp underside
Dew point underside
29
19
9
-1
Temperature (Deg C)
"05-Apr-32"
"12-Apr-32"
"19-Apr-32"
"26-Apr-32"
"03-May-32"
"10-May-32"
"17-May-32"
"24-May-32"
"31-May-32"
"07-Jun-32"
Date

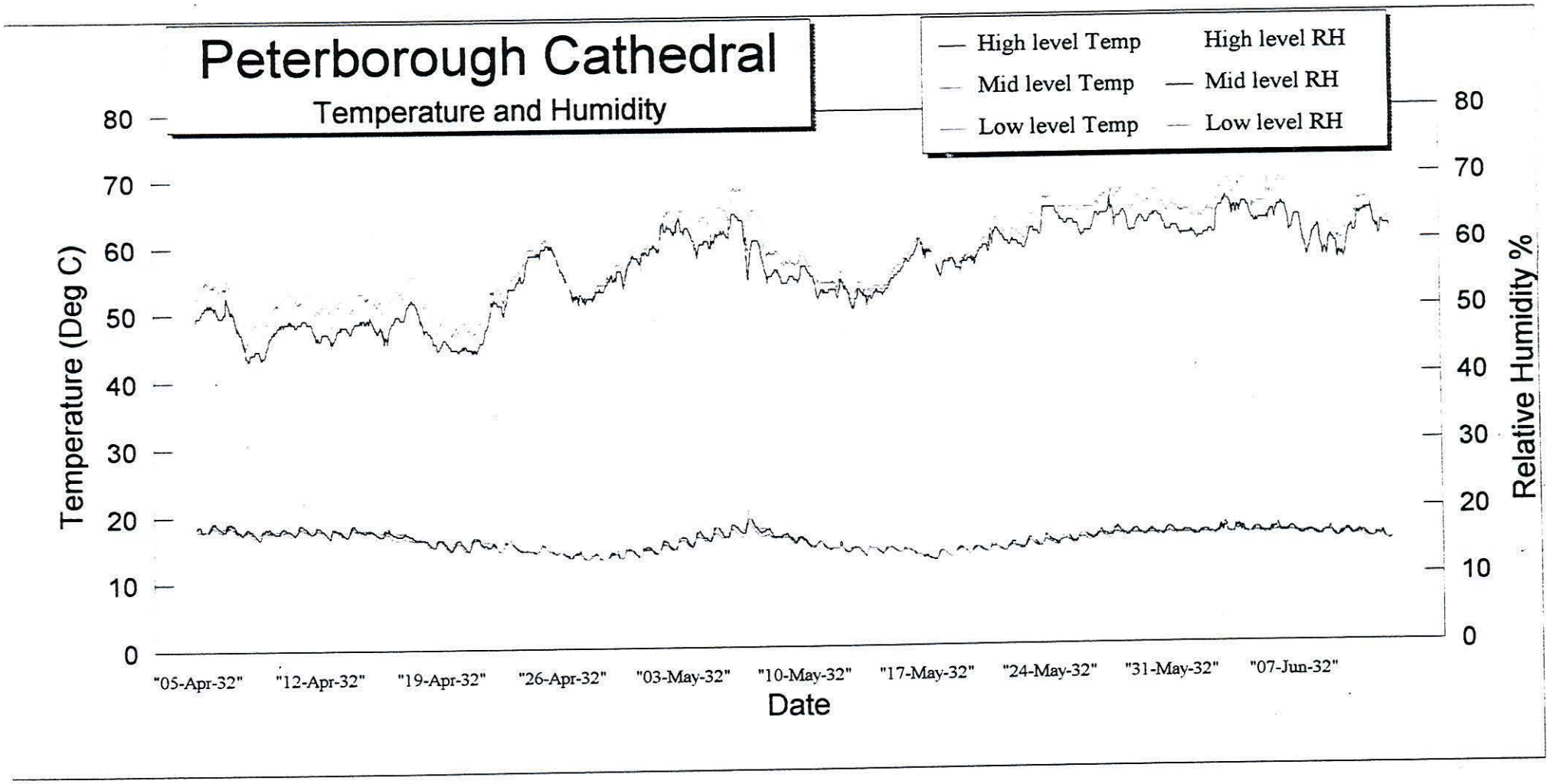
GRAPH 7.


Peterborough Cathedral
Vapour Pressure
Vapour press. in Cathedral
Vapour press. in roof space
Difference (inside - roof space)
Vapour Pressure (millibar)
2
1.5
1
0.5
0
-0.5
"05-Apr-32"
"12-Apr-32"
"19-Apr-32"
"26-Apr-32"
"03-May-32"
"10-May-32"
"17-May-32"
"24-May-32"
"31-May-32"
"07-Jun-32"
Date

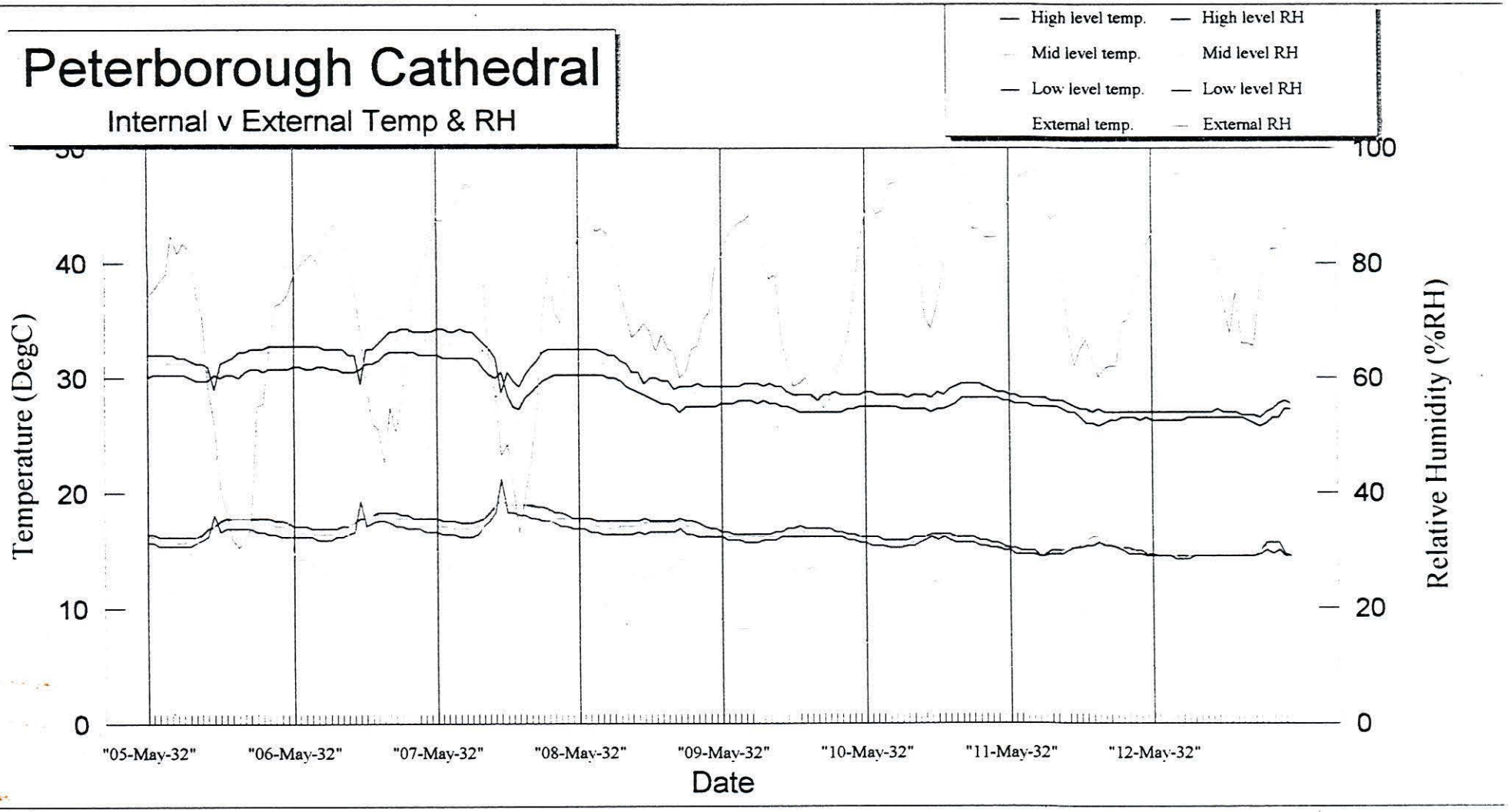
GRAPH 8.


Peterborough Cathedral
Internal v External Temp & RH
High level temp.
Mid level temp.
Low level temp.
External temp.
High level RH
Mid level RH
Low level RH
External RH
Temperature (DegC)
Relative Humidity (%RH)
0
10
20
30
40
0
20
40
60
80
100
"05-Apr-32"
"12-Apr-32"
"19-Apr-32"
"26-Apr-32"
"03-May-32"
"10-May-32"
"17-May-32"
"24-May-32"
"31-May-32"
"07-Jun-32"
Date

GRAPH 9.


Peterborough Cathedral
Temperature and Humidity
High level Temp
Mid level Temp
Low level Temp
High level RH
Mid level RH
Low level RH
Temperature (Deg C)
Relative Humidity %
0
10
20
30
40
50
60
70
80
"05-Apr-32"
"12-Apr-32"
"19-Apr-32"
"26-Apr-32"
"03-May-32"
"10-May-32"
"17-May-32"
"24-May-32"
"31-May-32"
"07-Jun-32"
Date

GRAPH 10.


Peterborough Cathedral
Internal v External Temp & RH
High level temp.
Mid level temp.
Low level temp.
External temp.
High level RH
Mid level RH
Low level RH
External RH
Temperature (DegC)
Relative Humidity (%RH)
0
10
20
30
40
0
20
40
60
80
100
"05-May-32"
"06-May-32"
"07-May-32"
"08-May-32"
"09-May-32"
"10-May-32"
"11-May-32"
"12-May-32"
Date