

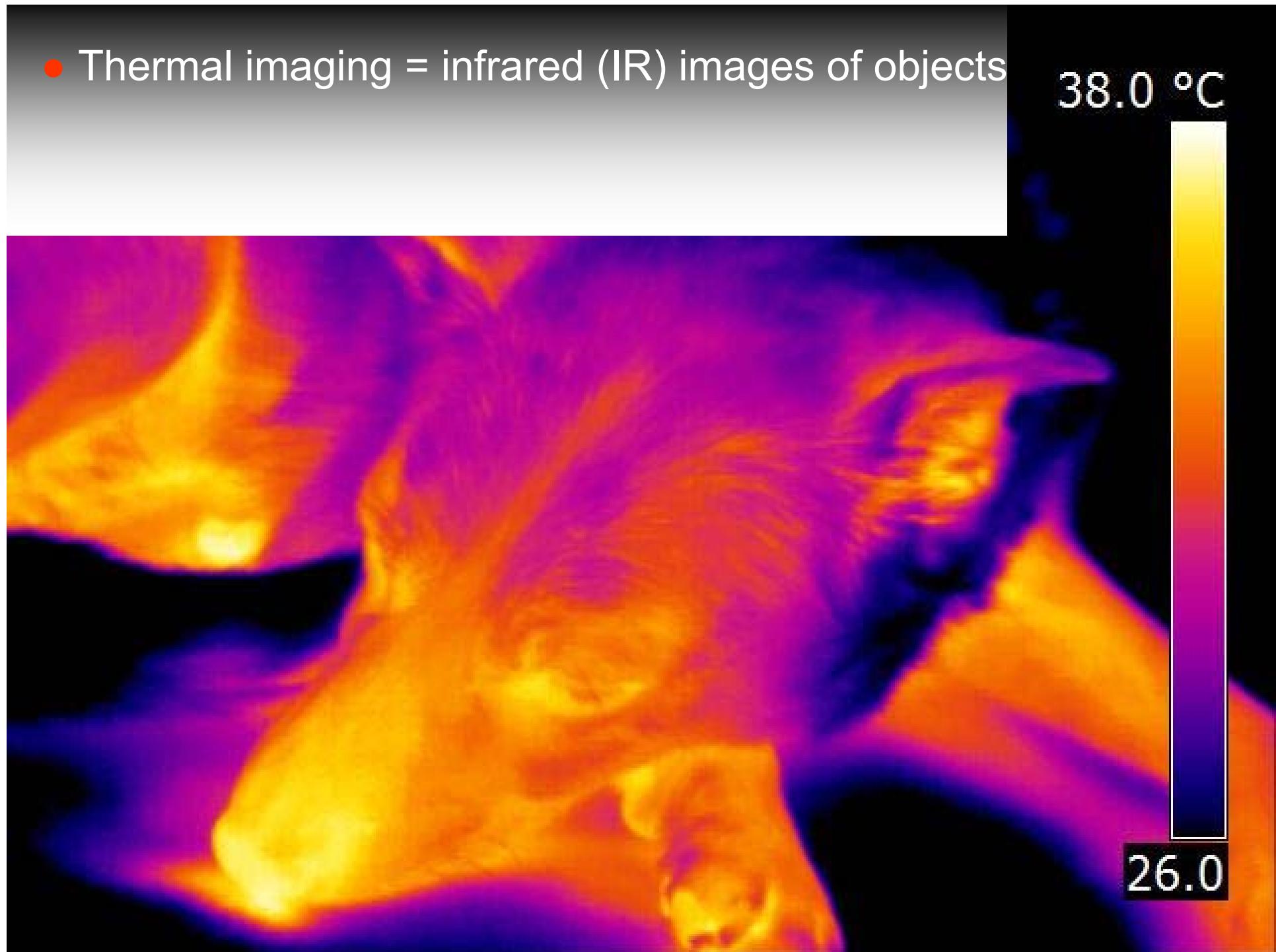
Applications of thermography: benefits and pitfalls

Dr. Maureen Young

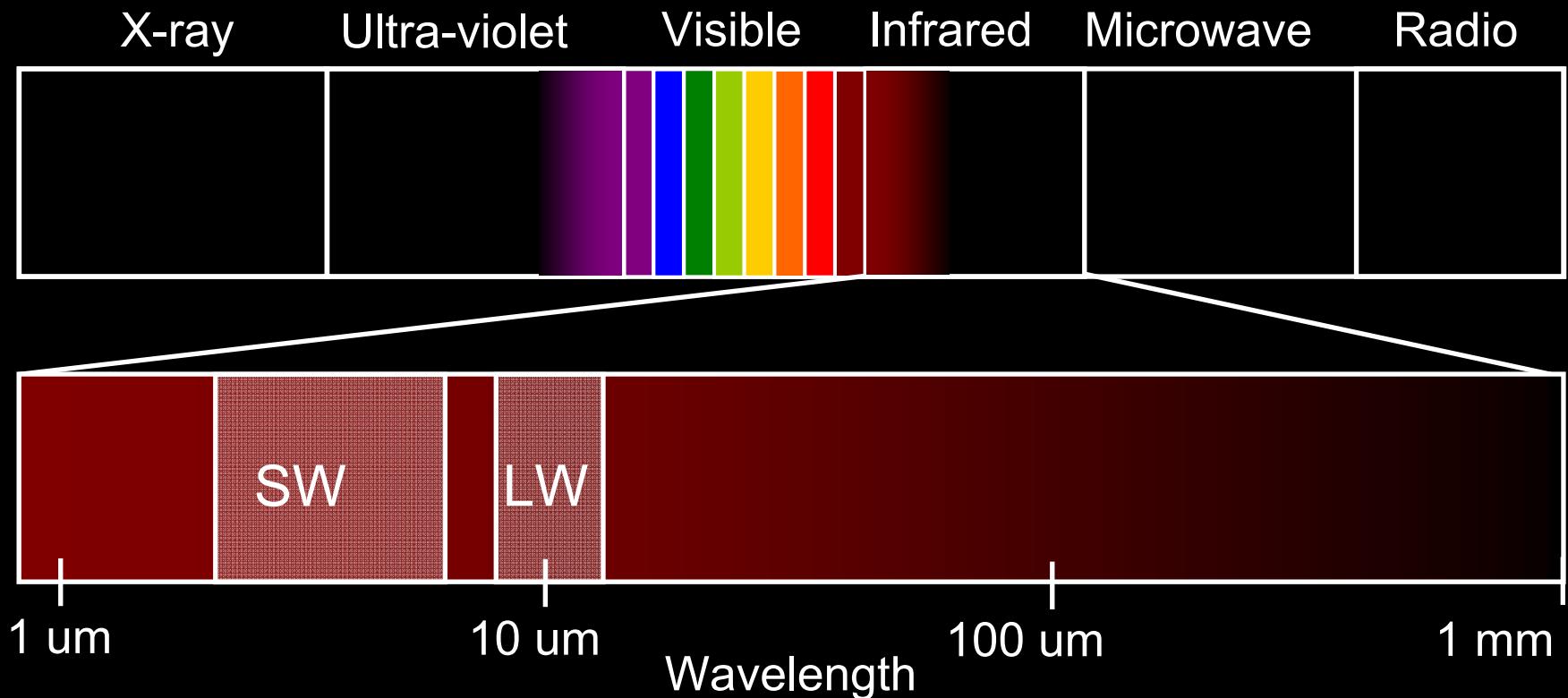


**Historic Scotland
Technical Conservation Group
Conservation Centre
7 South Gyle Crescent
Edinburgh EH12 9EB**

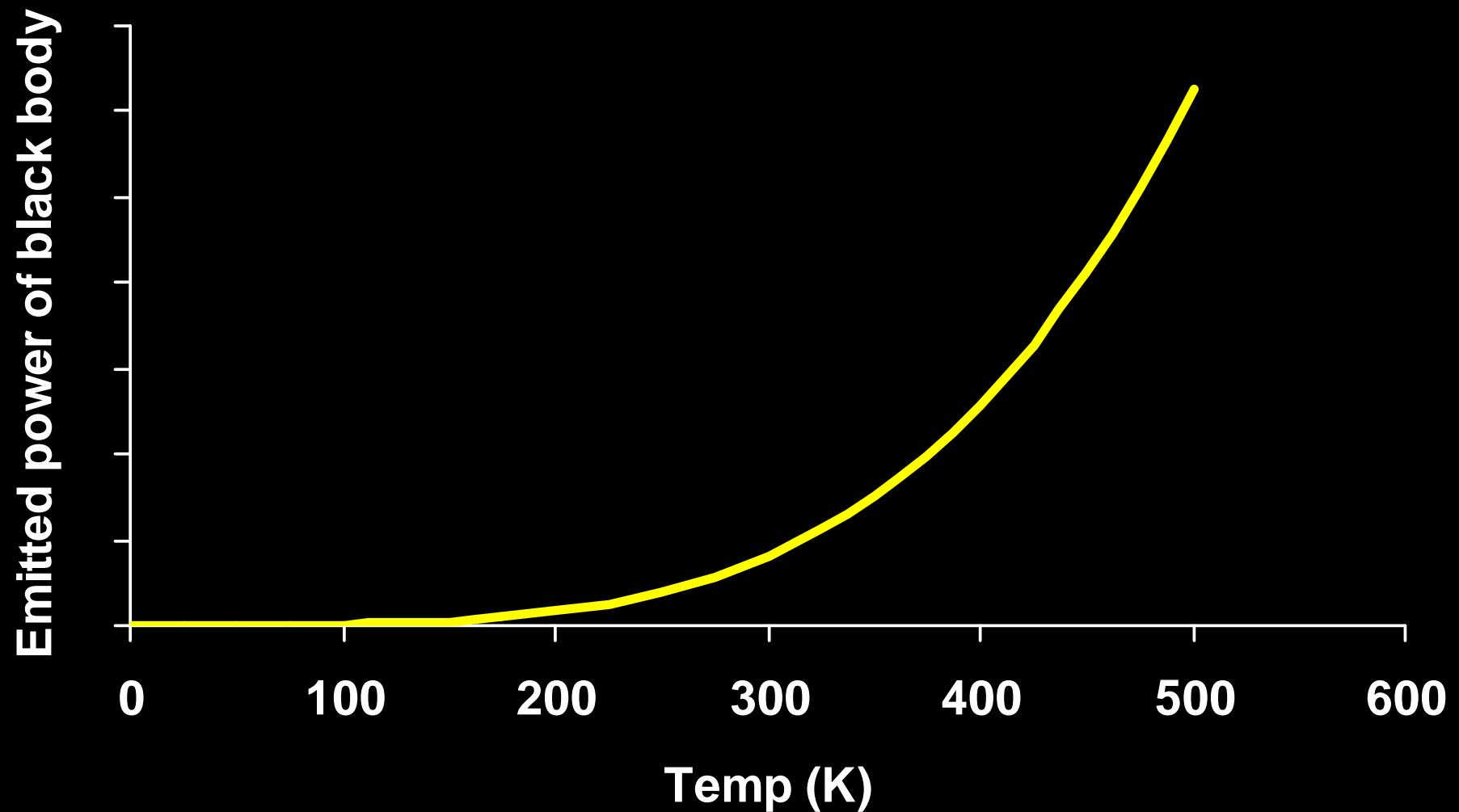
- Thermal imaging = infrared (IR) images of objects



- Infrared is a form of light invisible to the human eye
- Infrared radiation occurs beyond the red end of the visible light spectrum
- IR cameras use short wave (SW) or long wave (LW) IR light for different applications

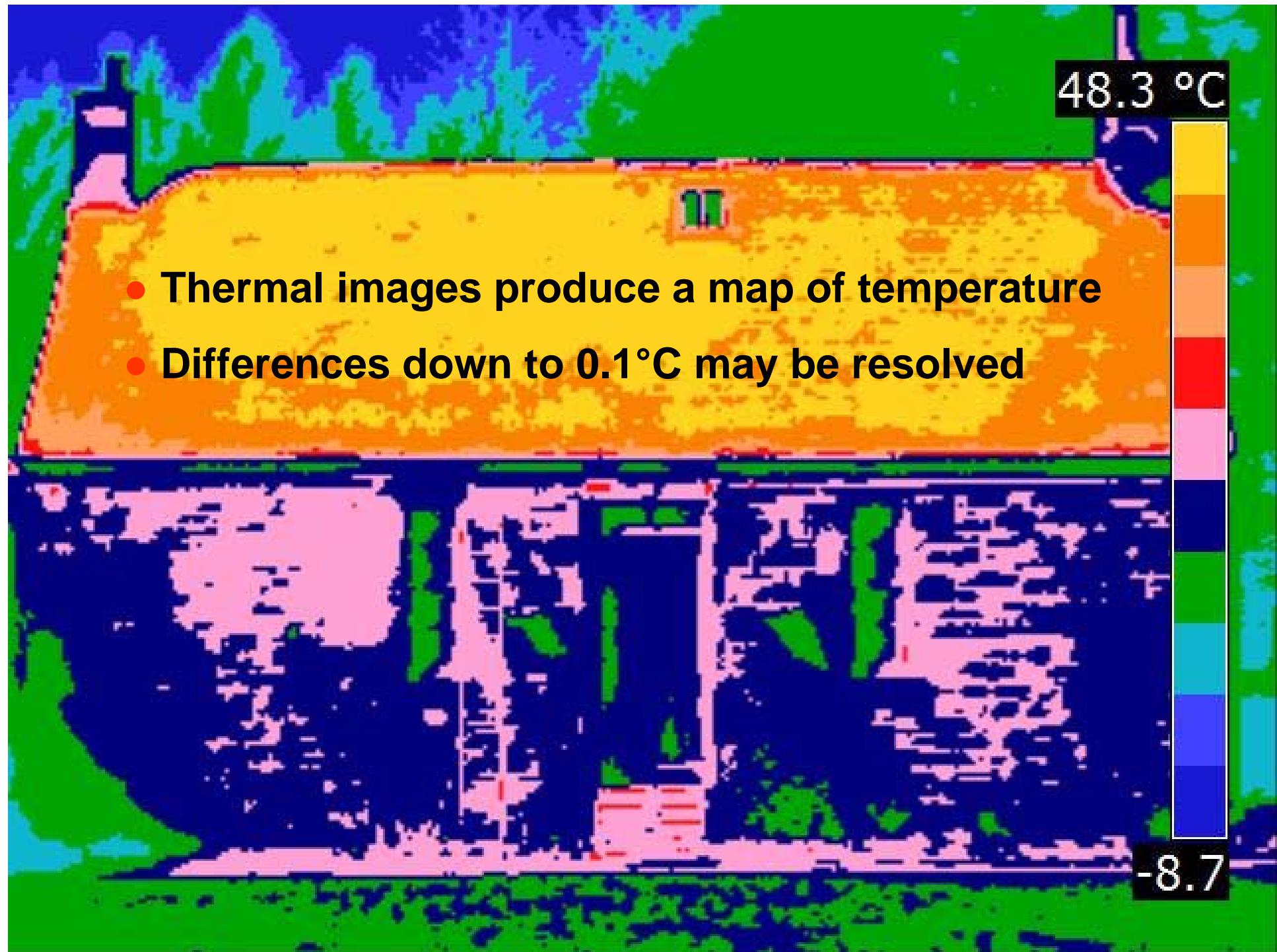


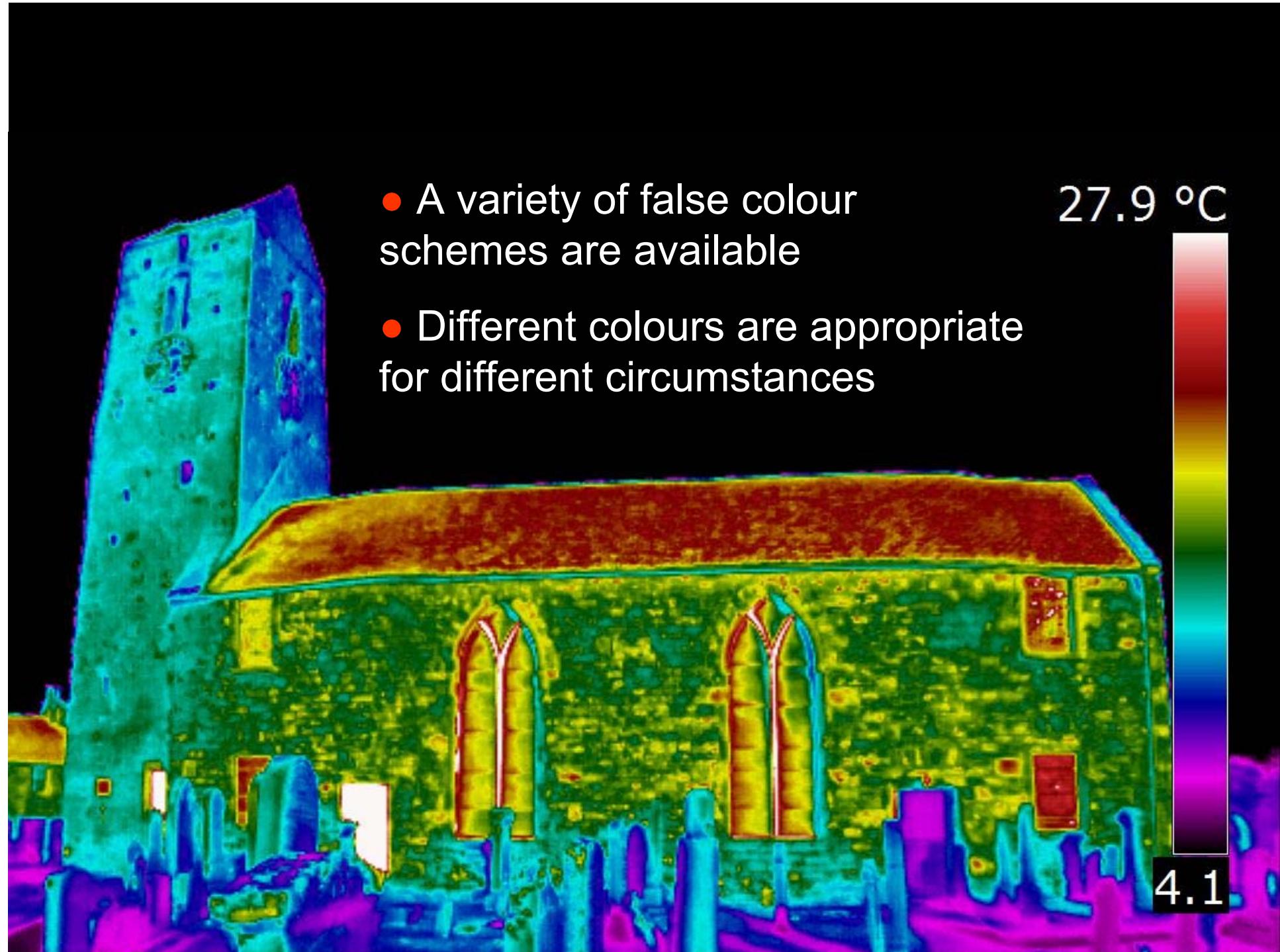
- All objects warmer than absolute zero (-273°C) emit IR
- The warmer an object is, the more IR energy it gives off
- The camera translates emitted energy to a temperature





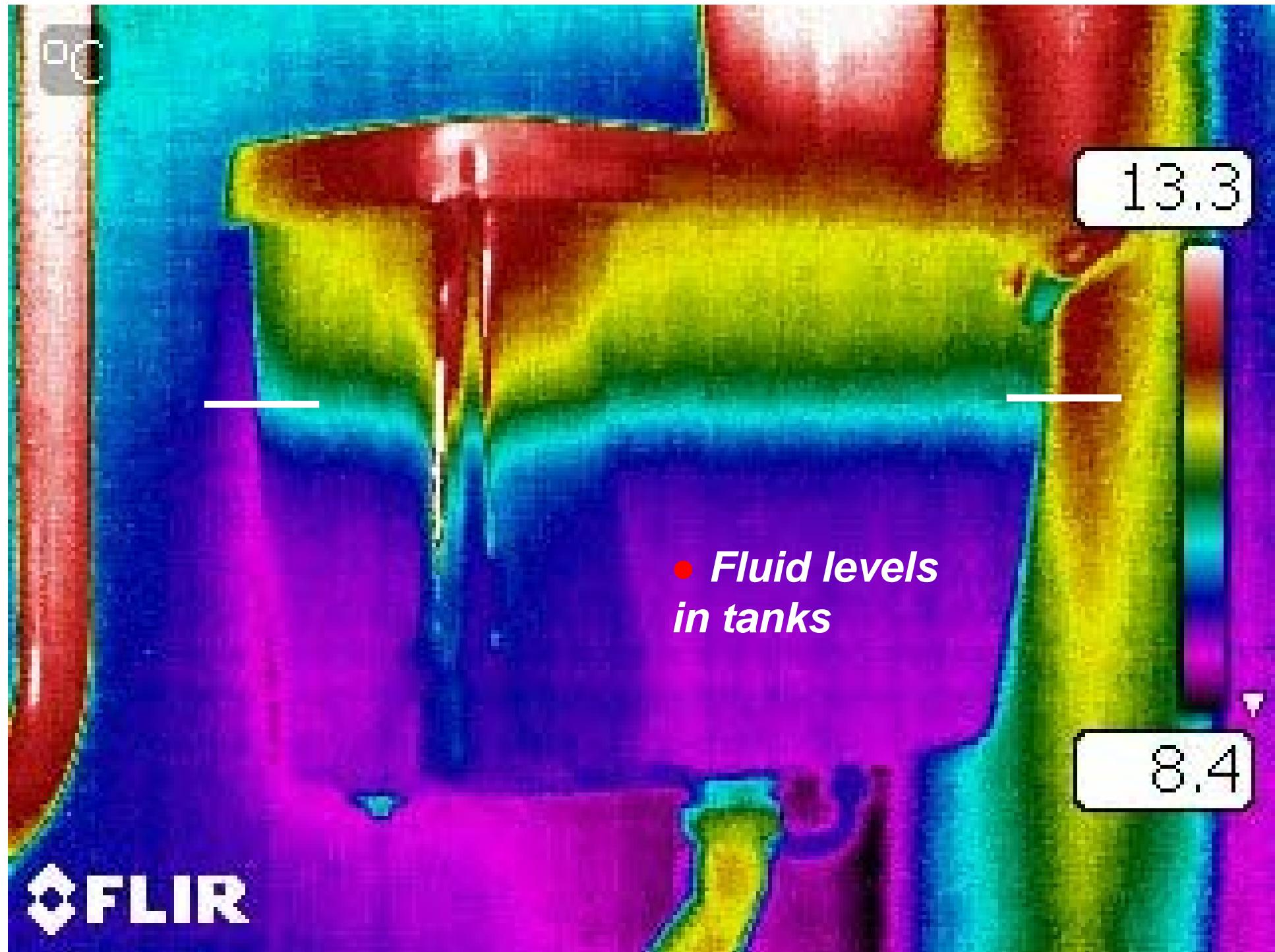
- An IR camera produces digital images similar to normal visual images, but it uses infrared rather than visible light
- These are '*thermograms*'
- Software in the camera converts the intensity of IR radiation to a temperature, shown on the scale on the right of the image

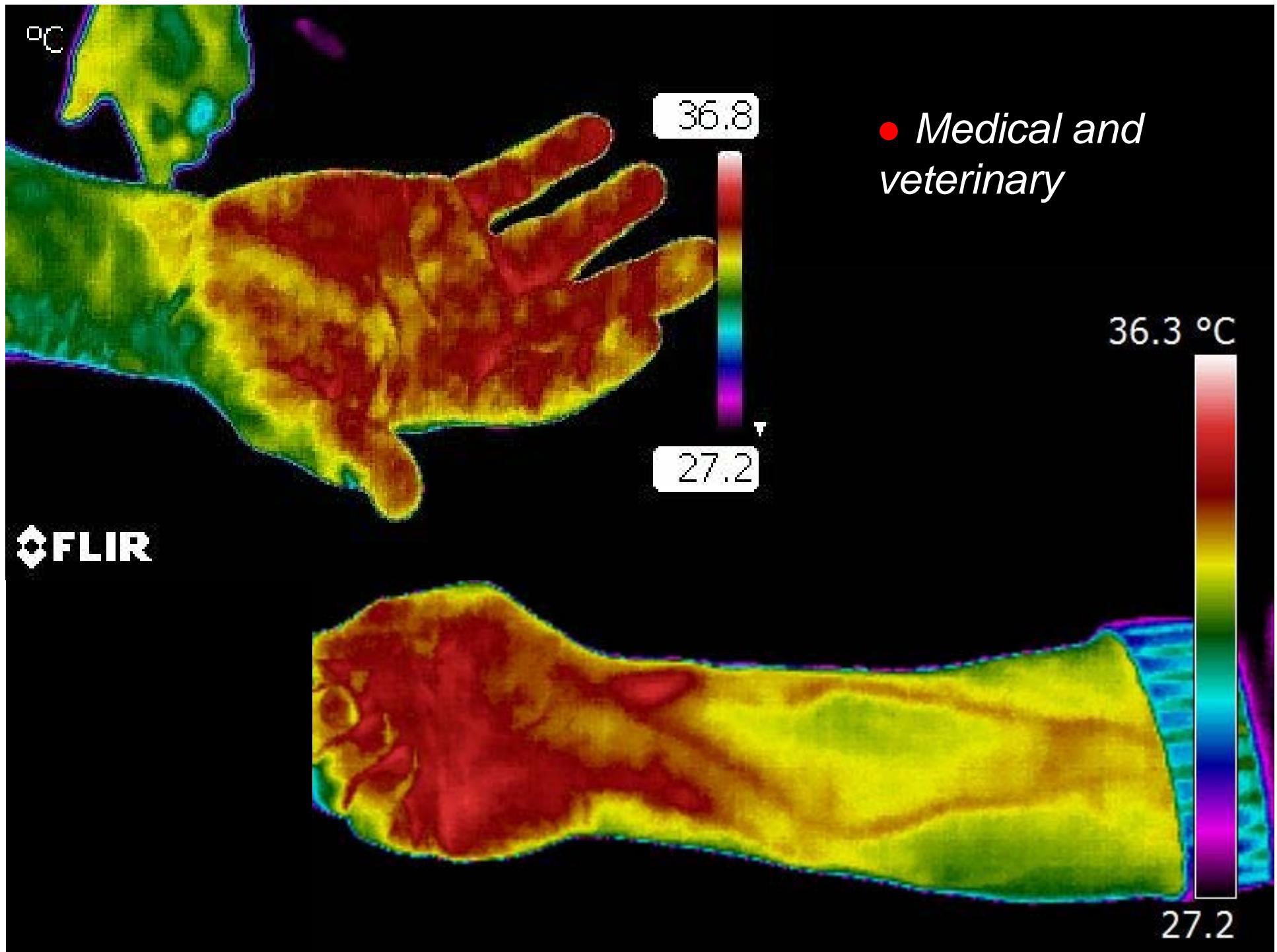


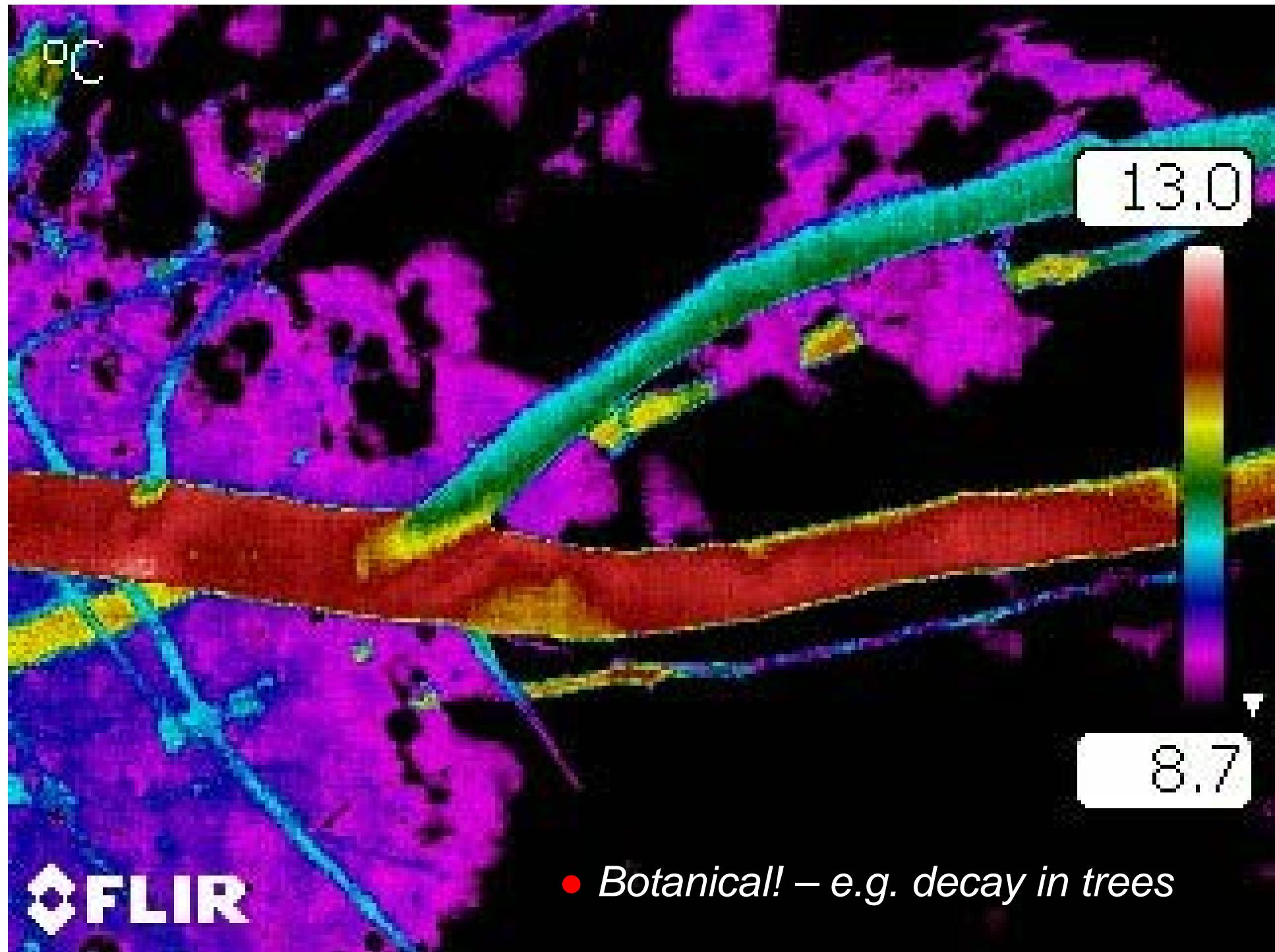


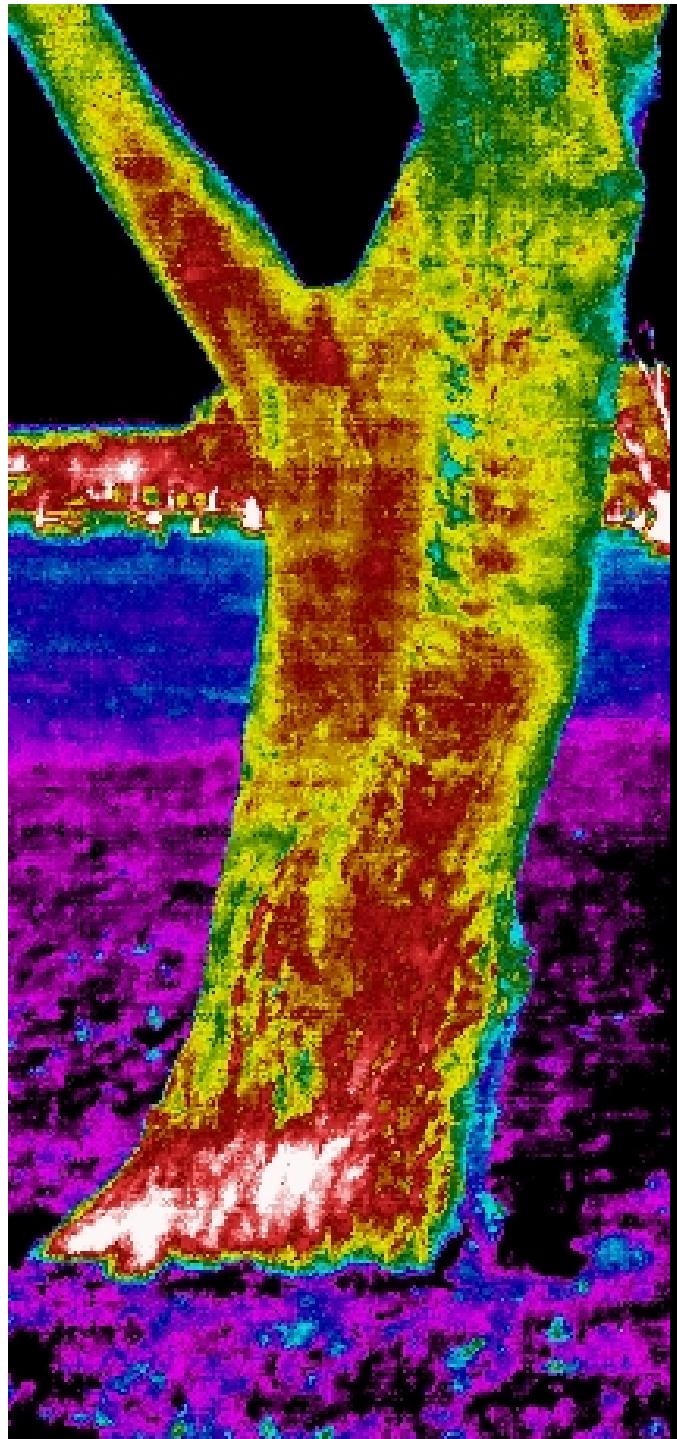
- IR has a wide range of applications



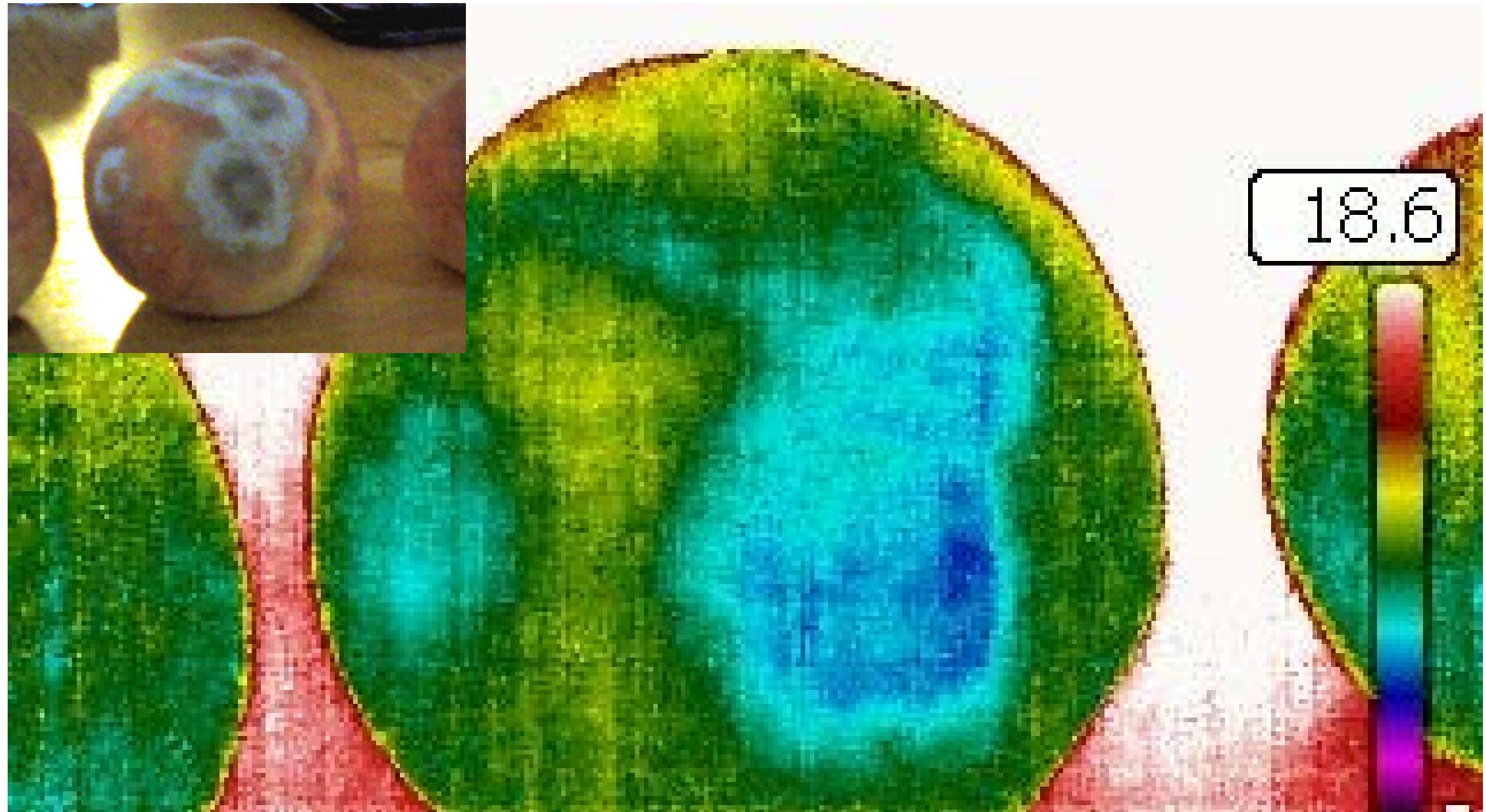








● ... or infections



- etc.... *Anything which results in differences in temperature*

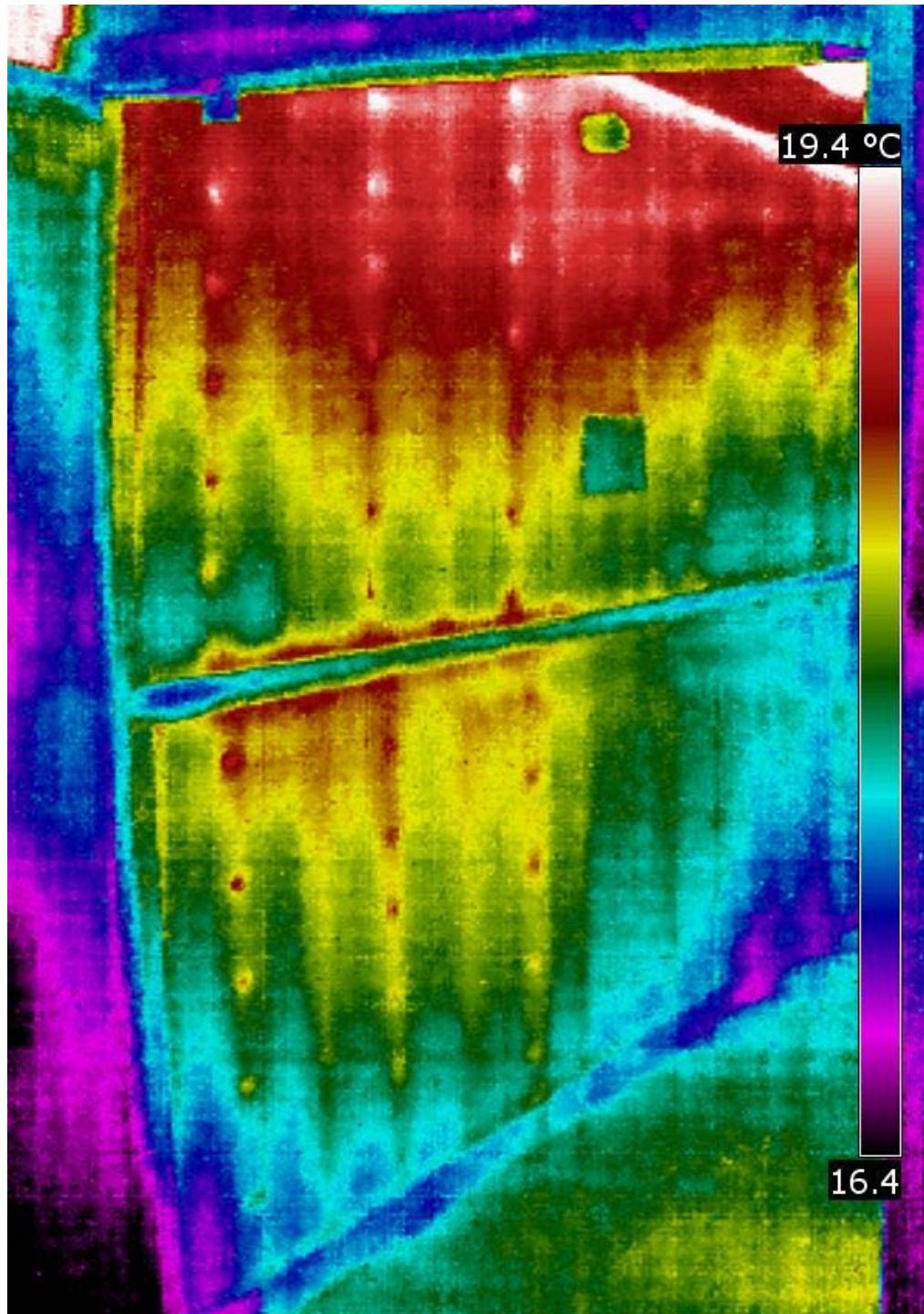
Thermography in the building industry

- Inconsistencies in the thermal image are called ‘anomalies’ and they may indicate a problem with the building fabric
- Potential problems that can be identified by thermography include:
 - *voids*
 - *delamination*
 - *cracks*
 - *dampness*
 - *defective insulation*
 - *hidden structure*

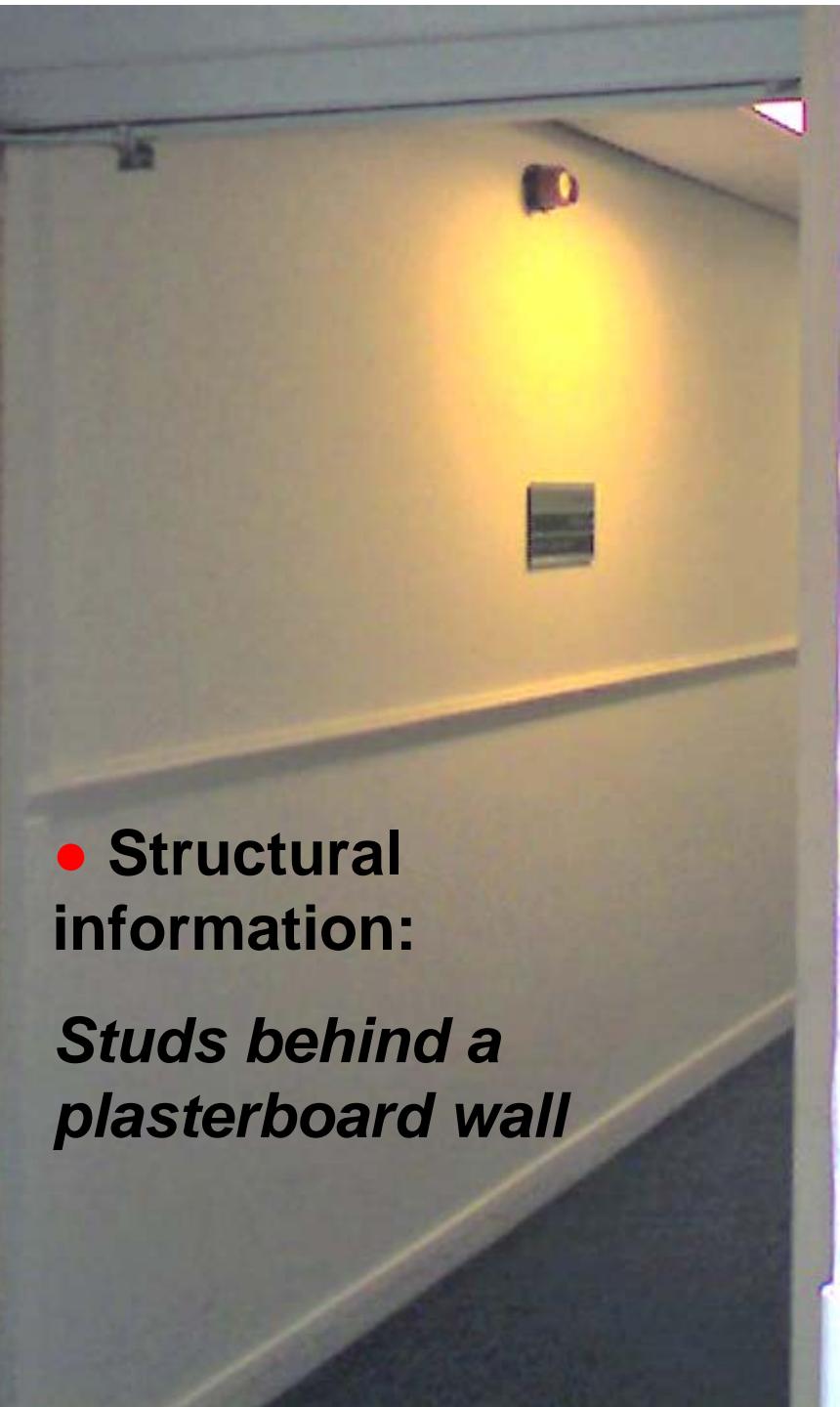


- Thermal surveys cannot be carried out after rainfall
- ... or if wind speed is too high (>20 mph) as temperature differences will be 'blown' off the surface of the building

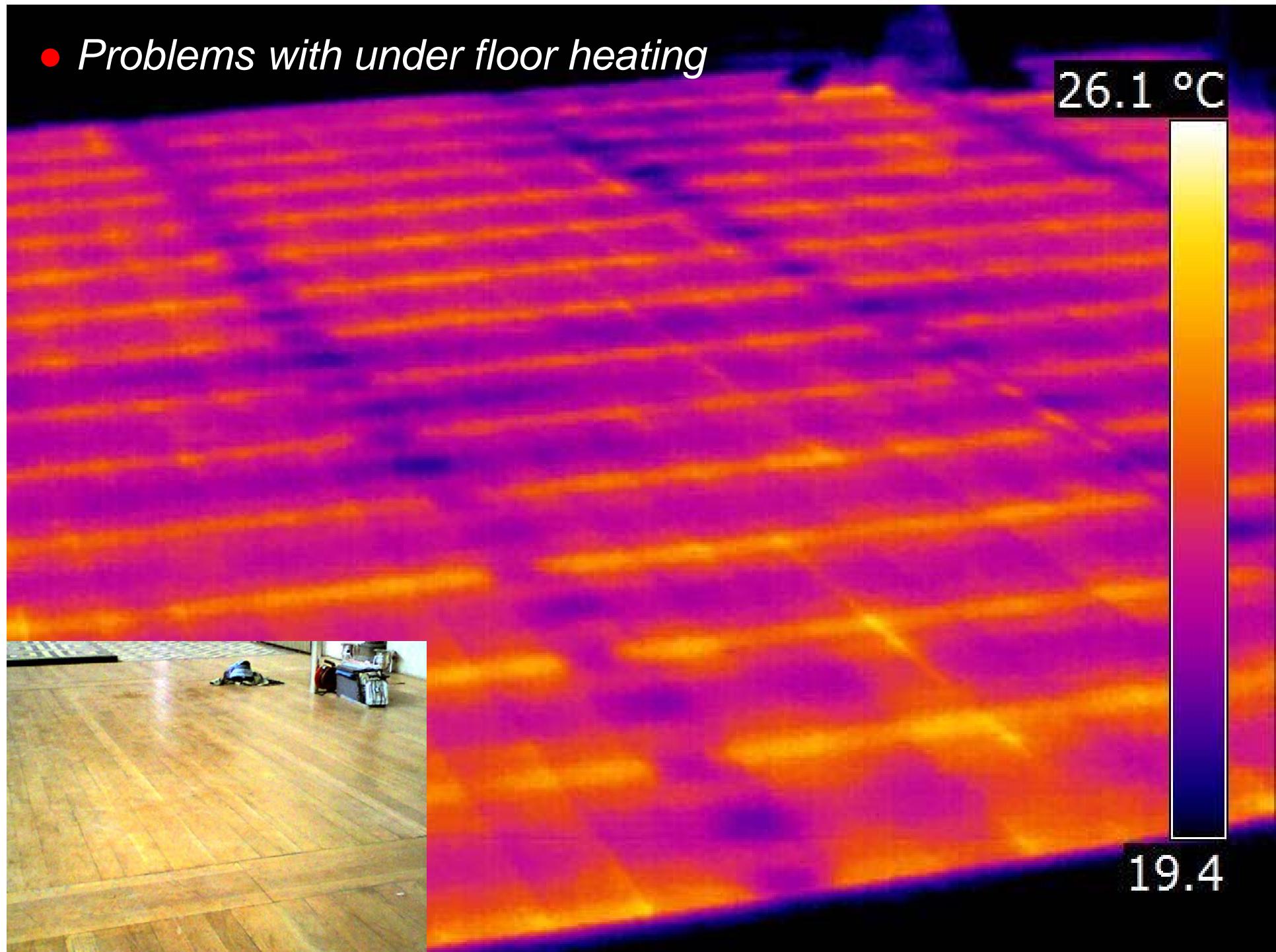




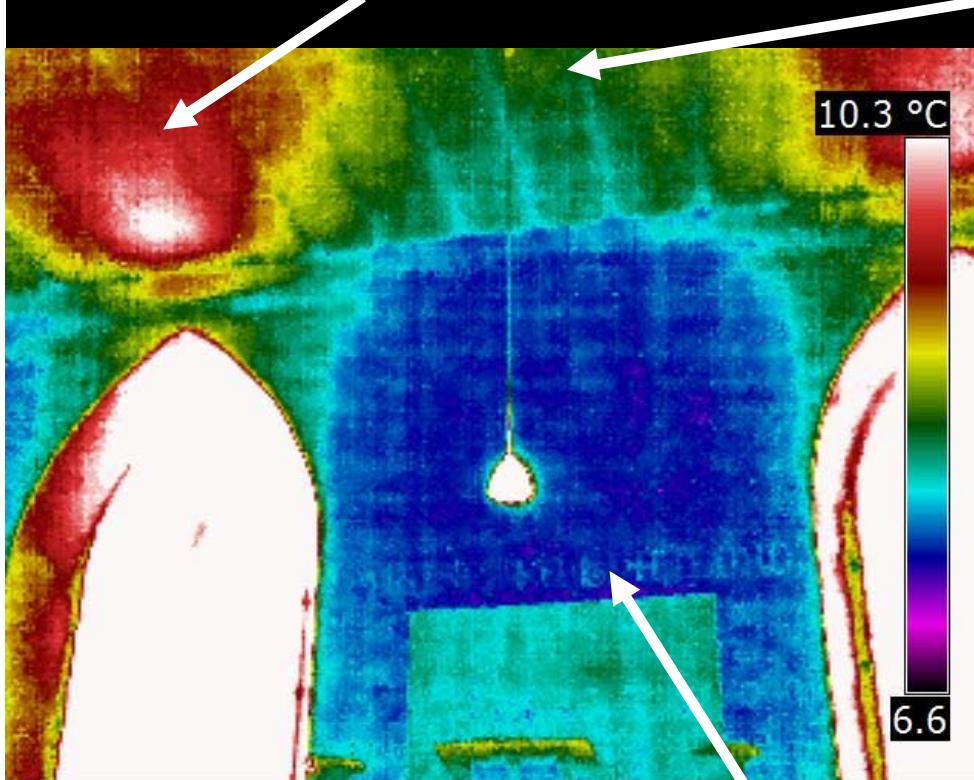
- Structural information:
Studs behind a plasterboard wall



- Problems with under floor heating



- Ceiling warmed by sunlight heating air inside the window

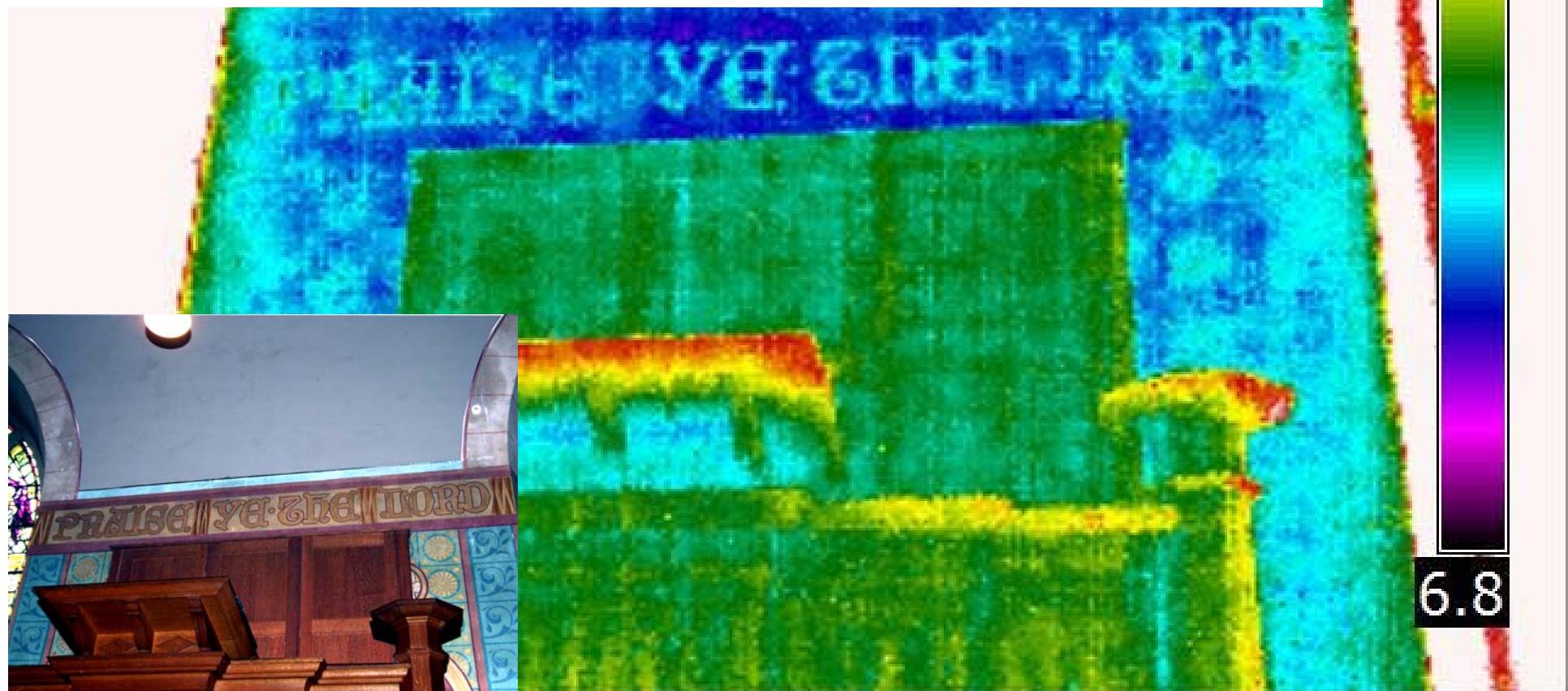


- Hidden structural information



• ?

- Gold text appears warmer than the wall, but it is at the same temperature
- The emissivity of the wall & gold paint is different



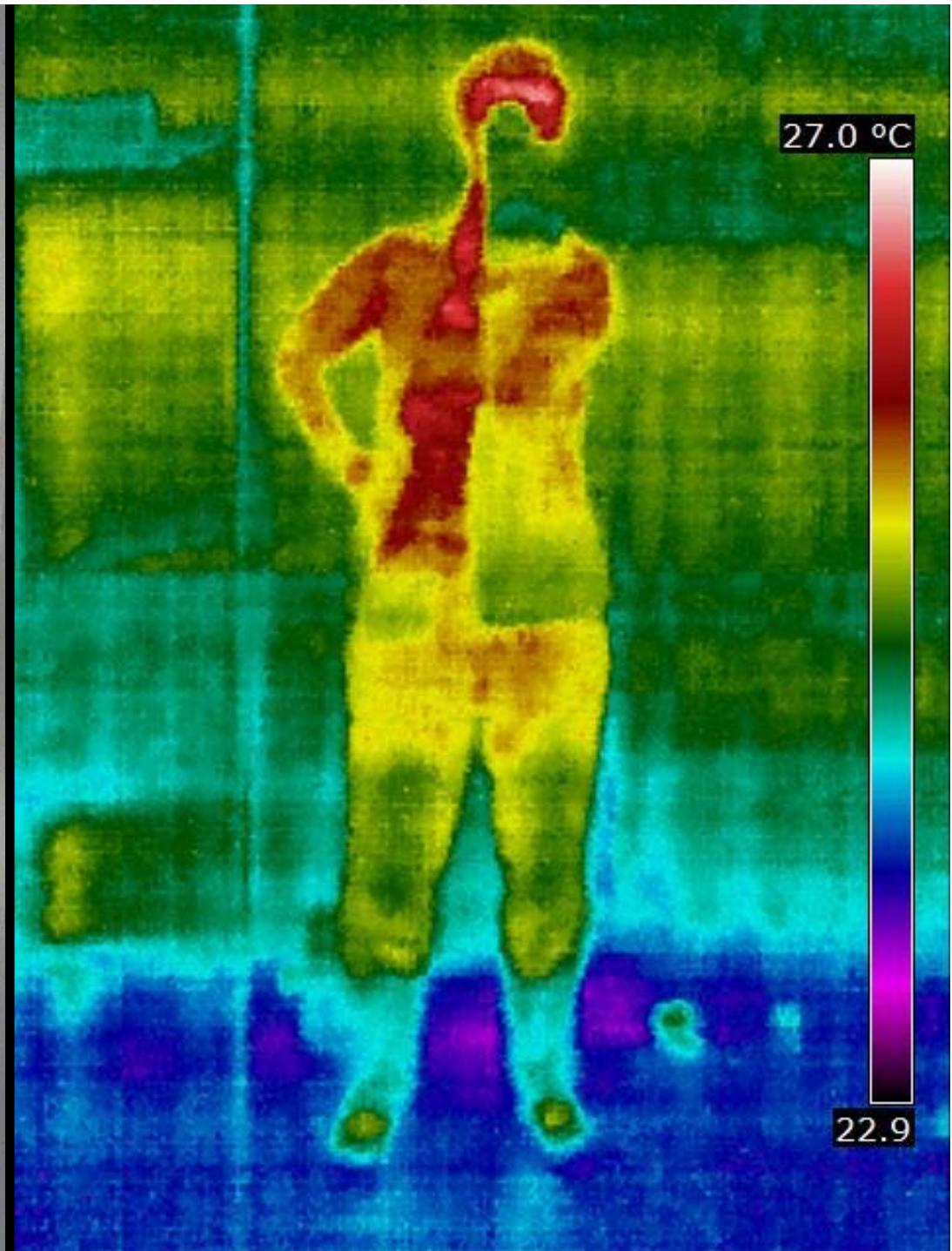
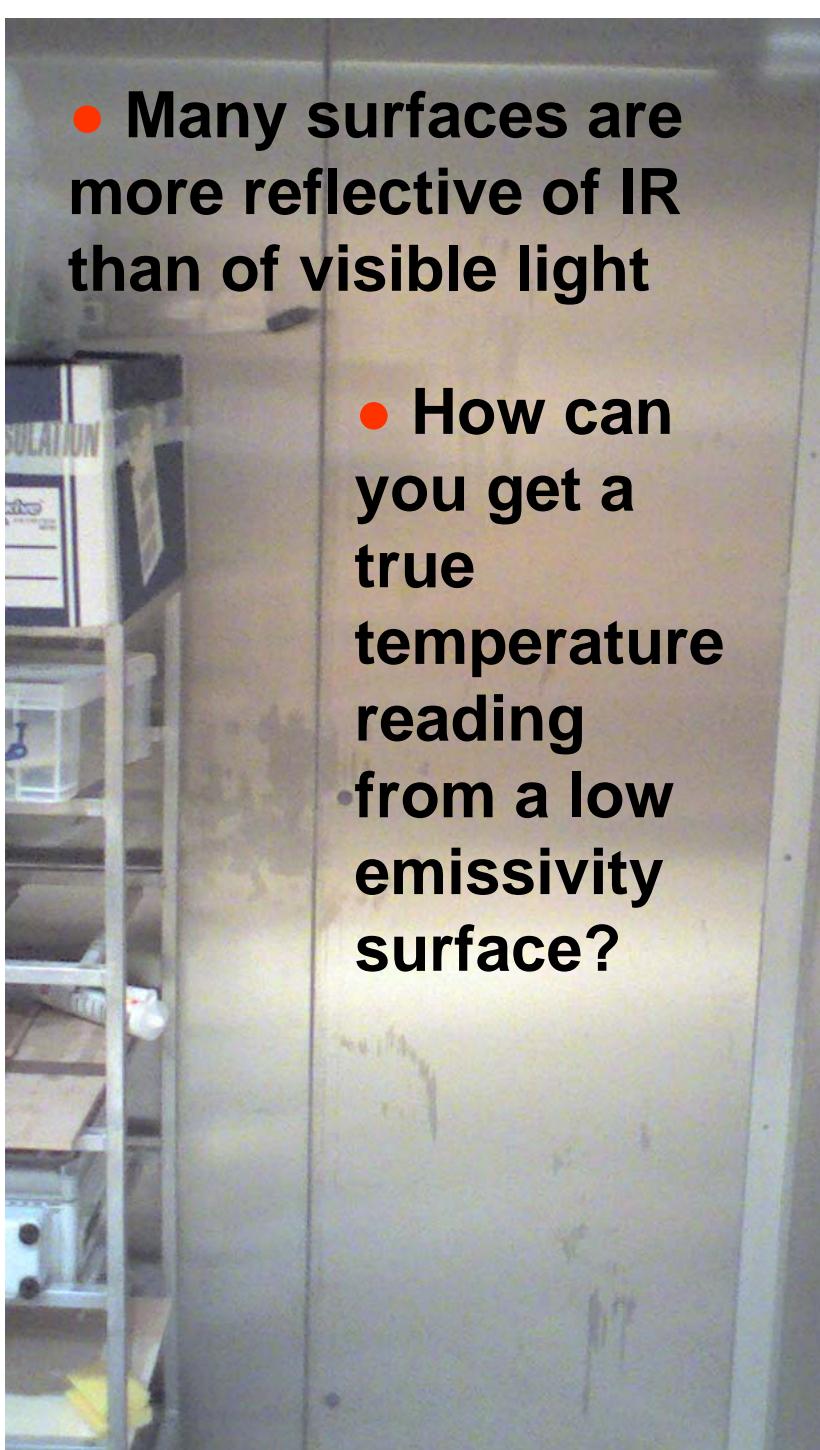
- The whole surface of this mug of hot water is at the same temperature, but the decoration appears to be colder

- This is because IR picked up by the camera is not all from *heat emissions* by the object
 - ... there is also *reflected heat* from surrounding objects
 - and some materials (e.g. many metals) emit very little IR, but reflect a lot – they have '*low emissivity*'

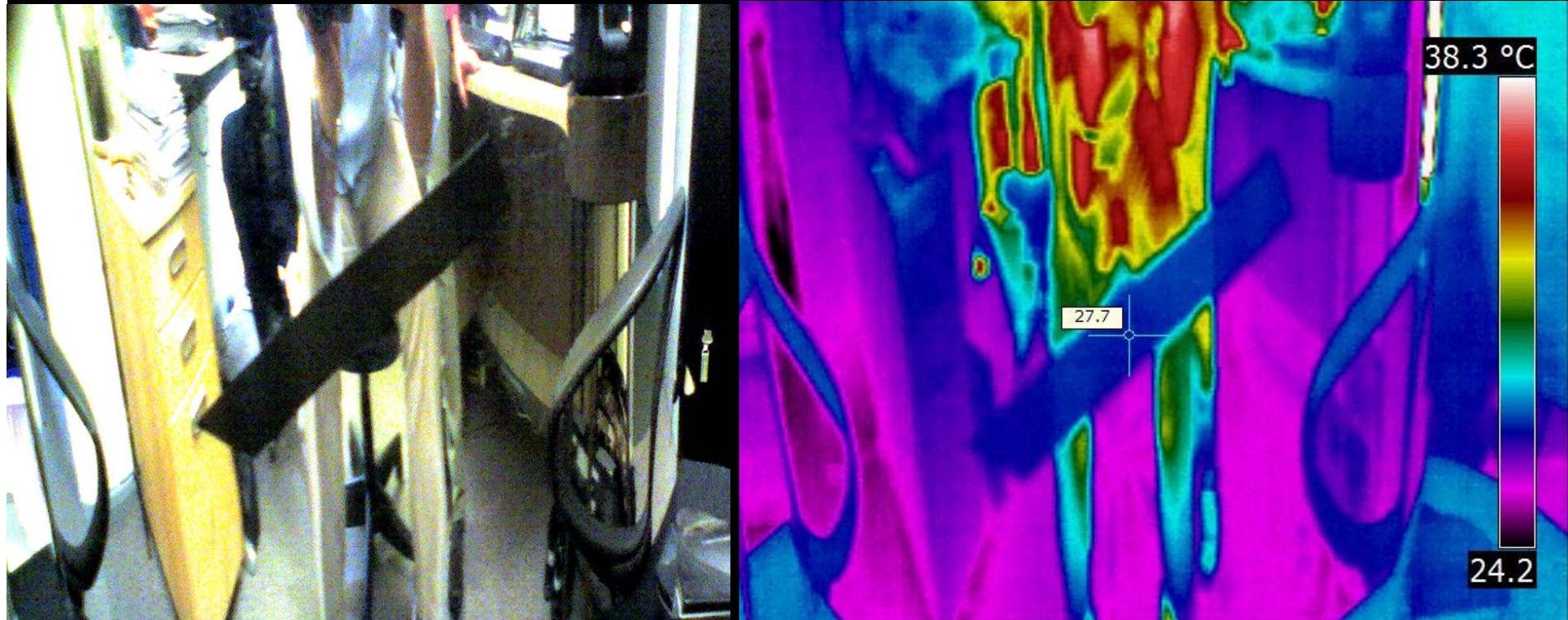


- Many surfaces are more reflective of IR than of visible light

- How can you get a true temperature reading from a low emissivity surface?



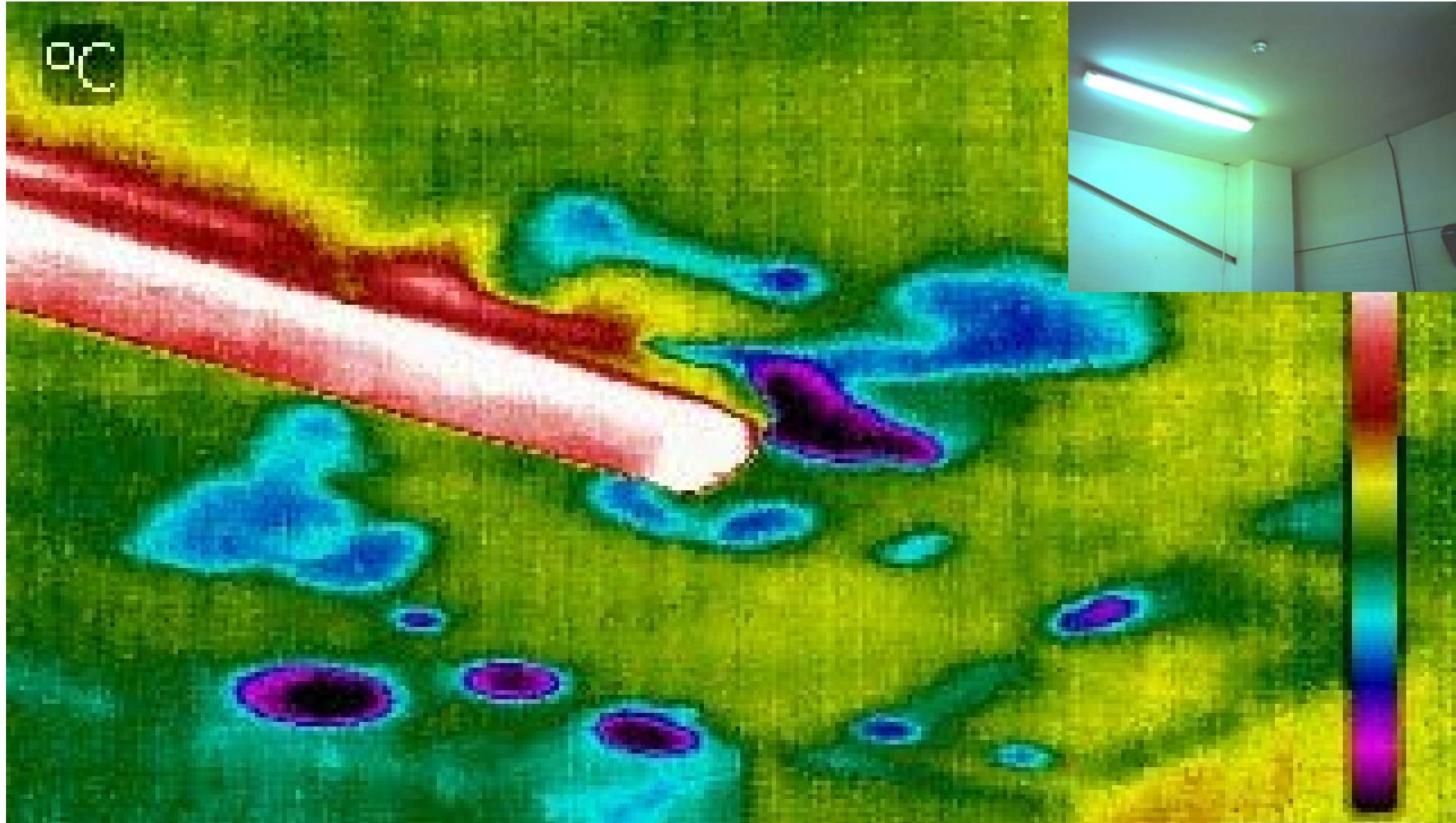
- ... you stick a bit of tape *of known emissivity* to the surface and take a spot temperature reading from the tape's surface



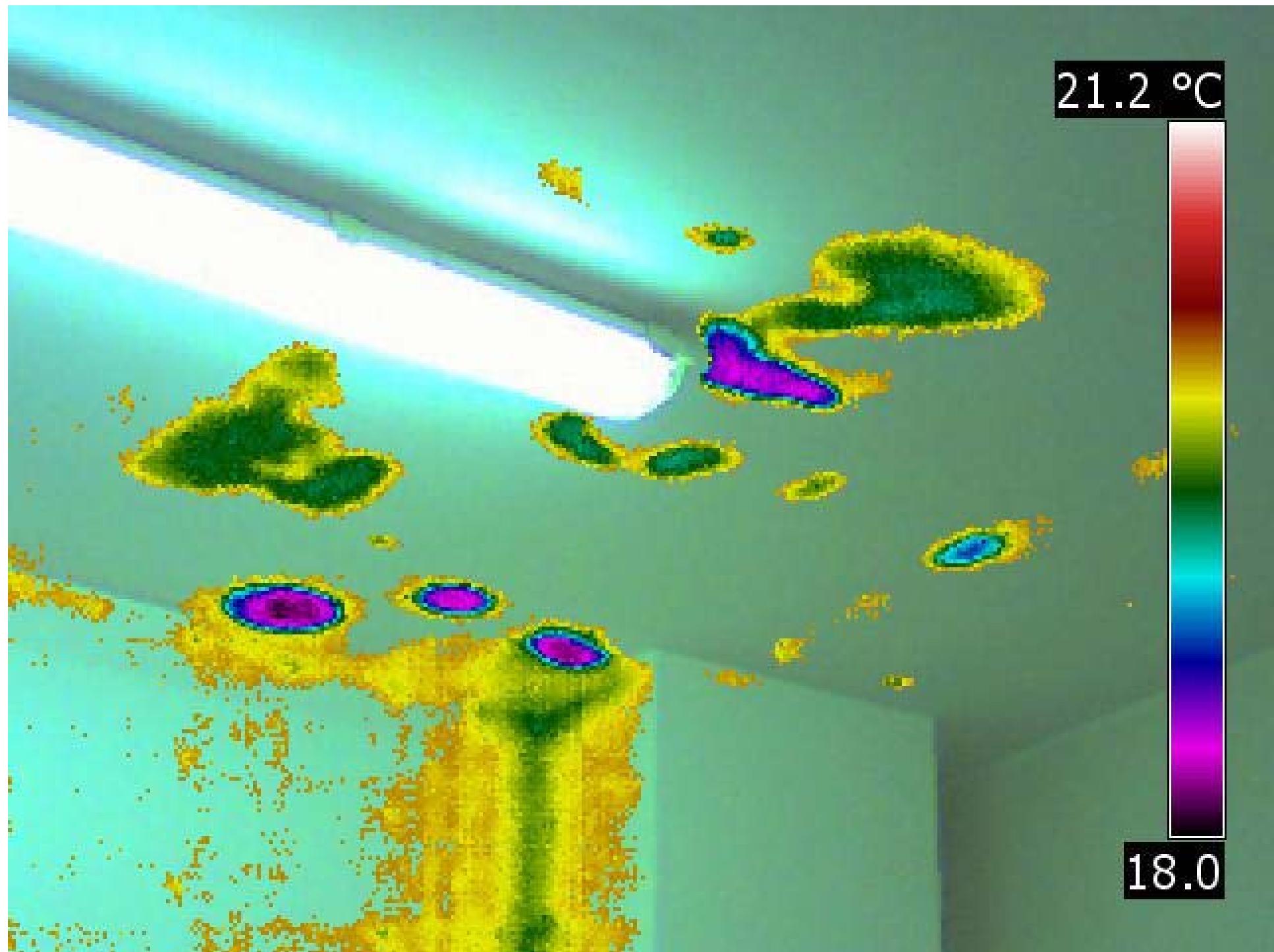
- So temperature data will only be correct if you **set the correct emissivity for the surface**

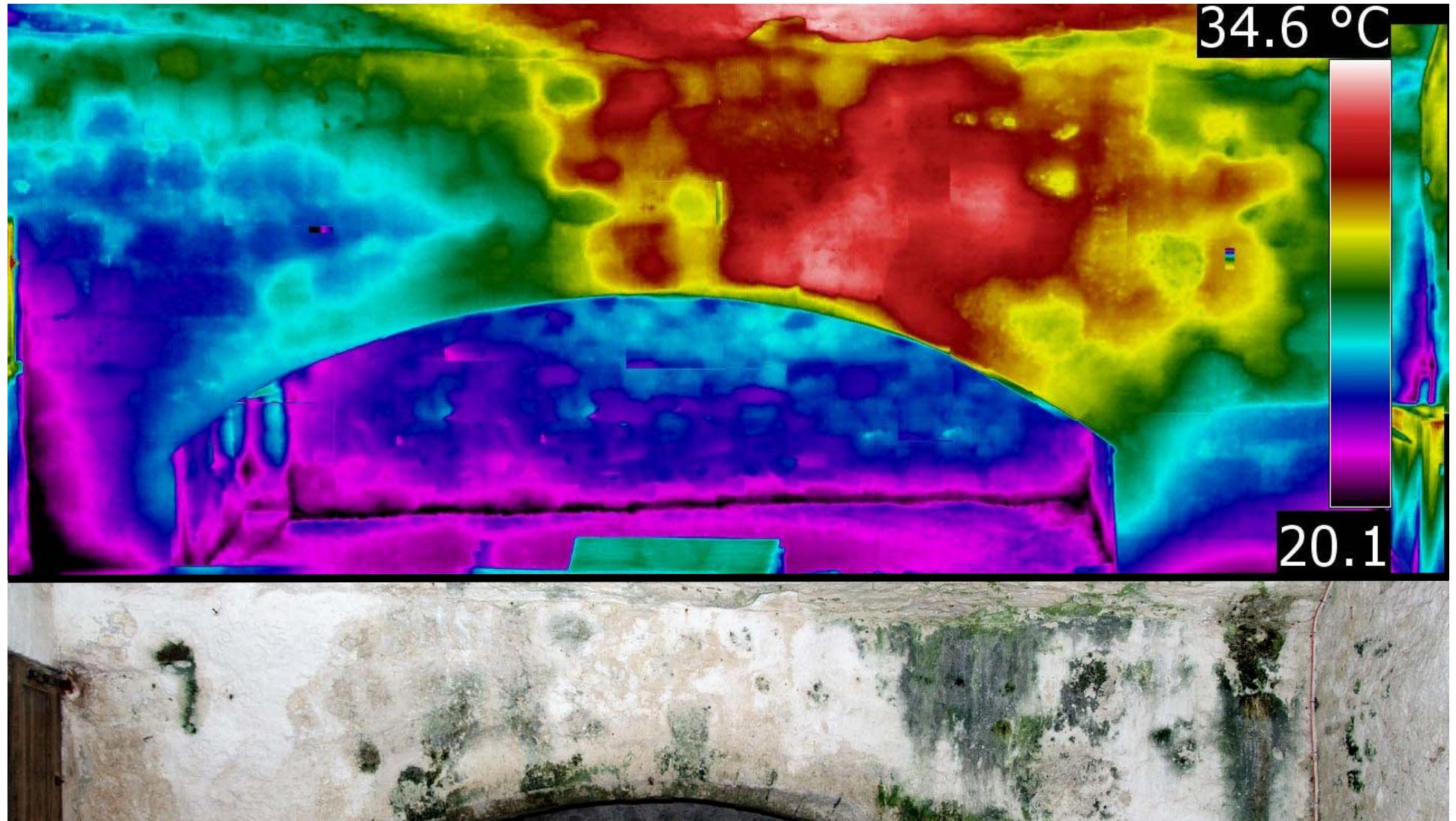
- We can also use IR for detection of dampness
- The damp patch is colder due to evaporation of moisture





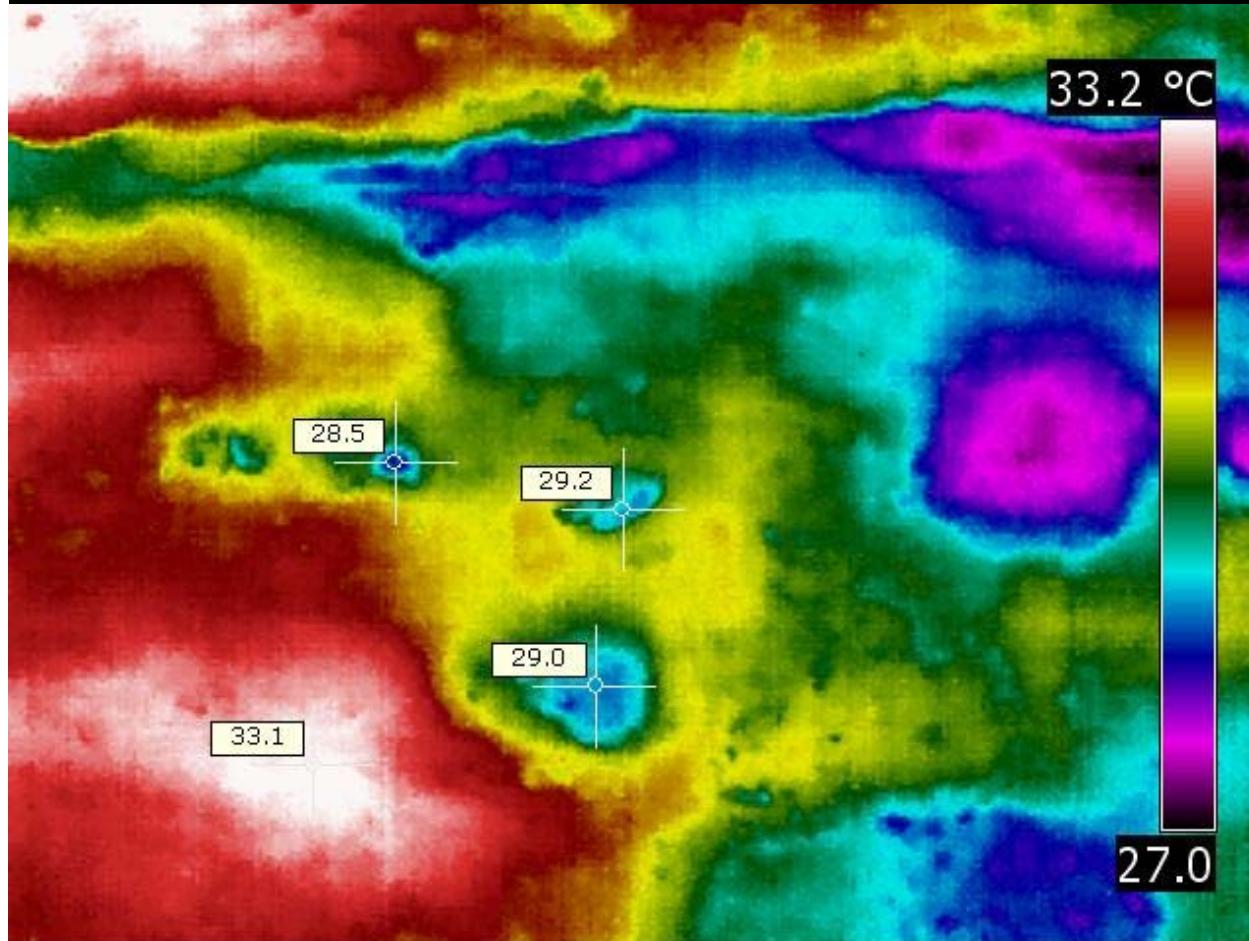
- Damp patches are colder when water evaporates, or cold water is leaking through





- ... but damp areas can also be *warmer*
- When heated, damp areas are warmer as water has a higher thermal capacity than most building materials

- ... just to confuse matters, damp patches on walls may be warmer & colder on the same wall at the same time!



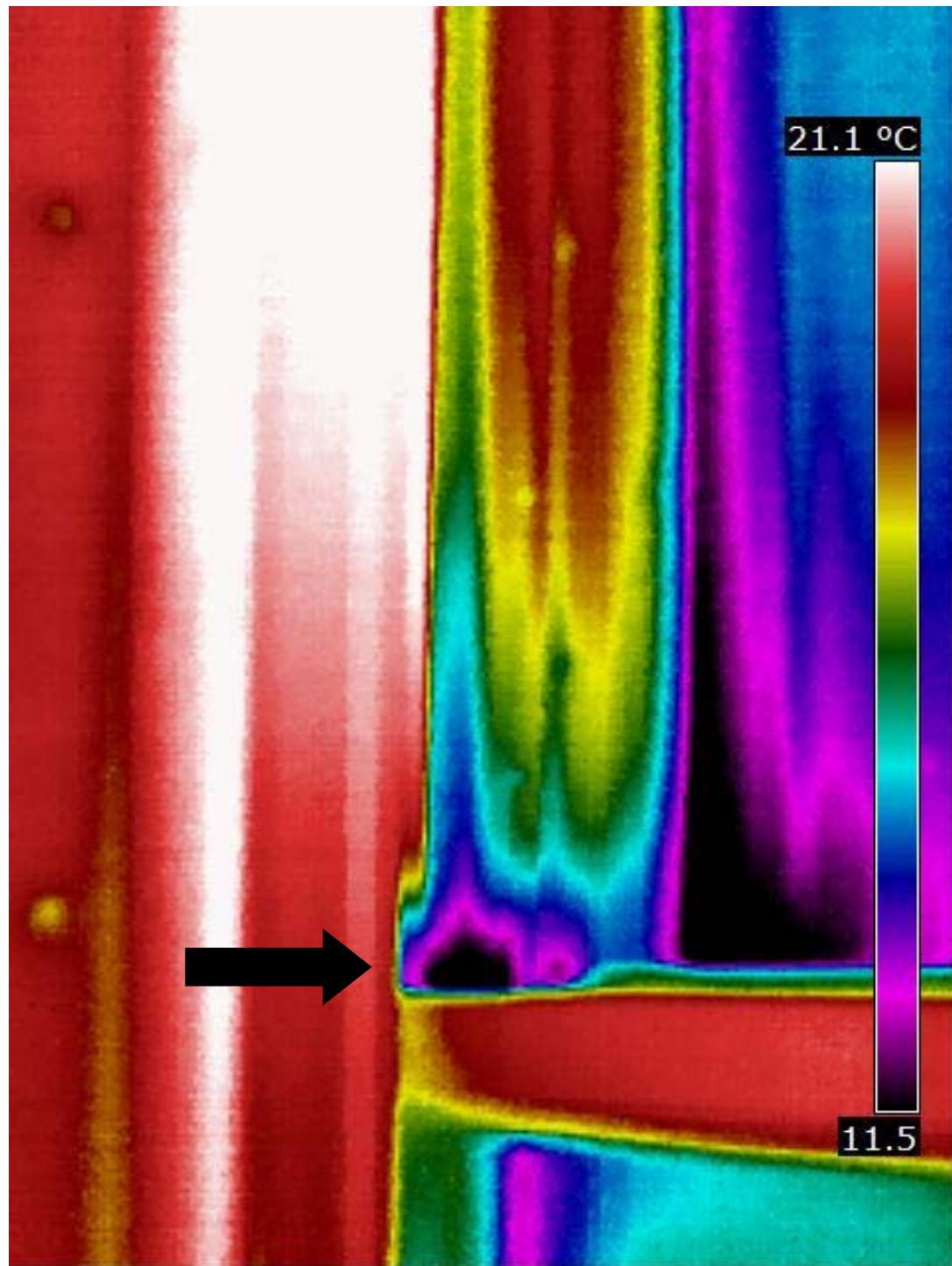
- Colder patches are wet *at the surface*, rather than below it



- You can't properly interpret a thermogram unless you ***understand what you're looking at***

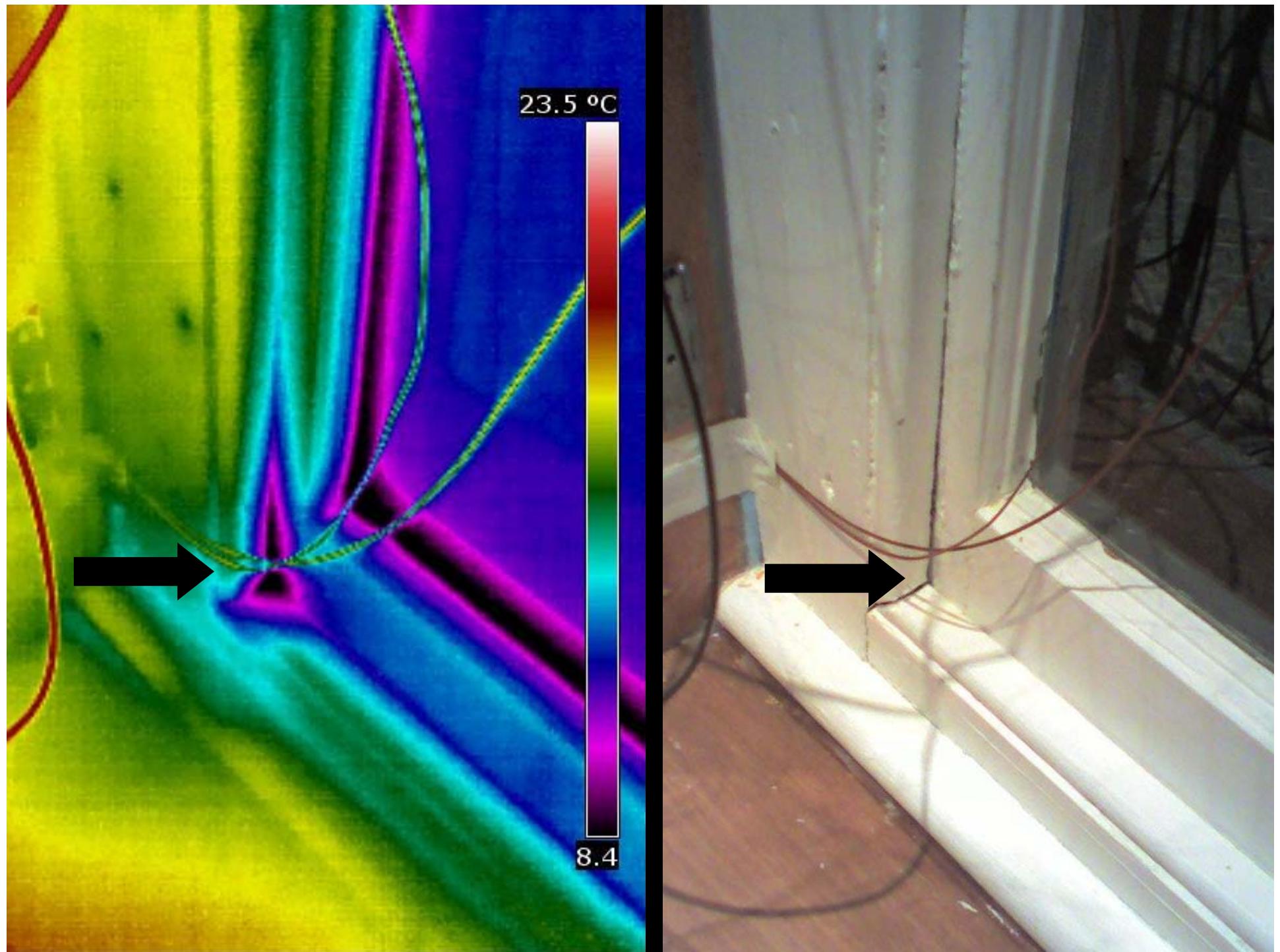
- Thermography can also give us information on heat loss from buildings
- It's obvious which of these houses has loft insulation





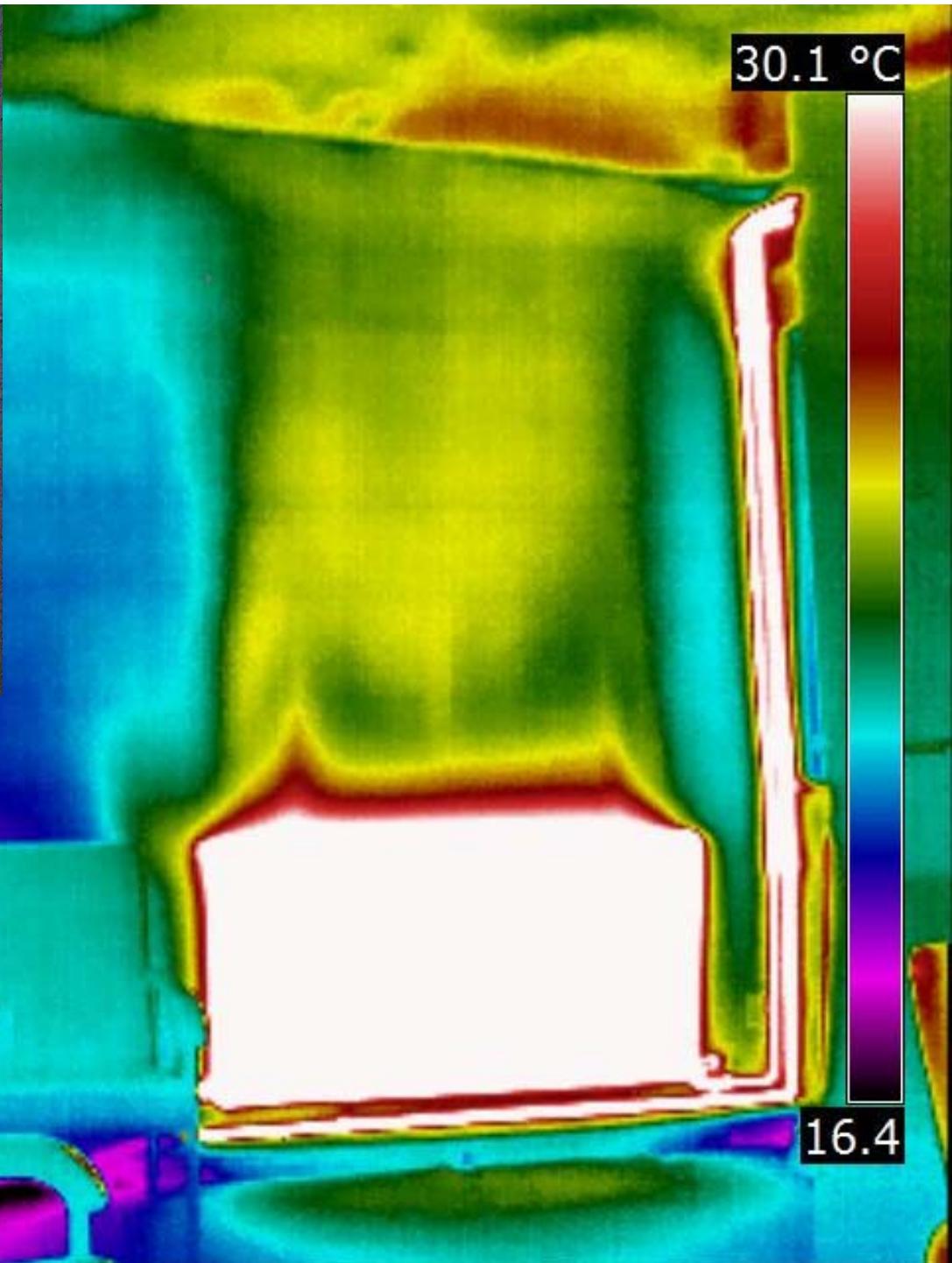
- Locate cold draughts at windows





- This wall has no insulation – the hot spot shows the location of a wall heater





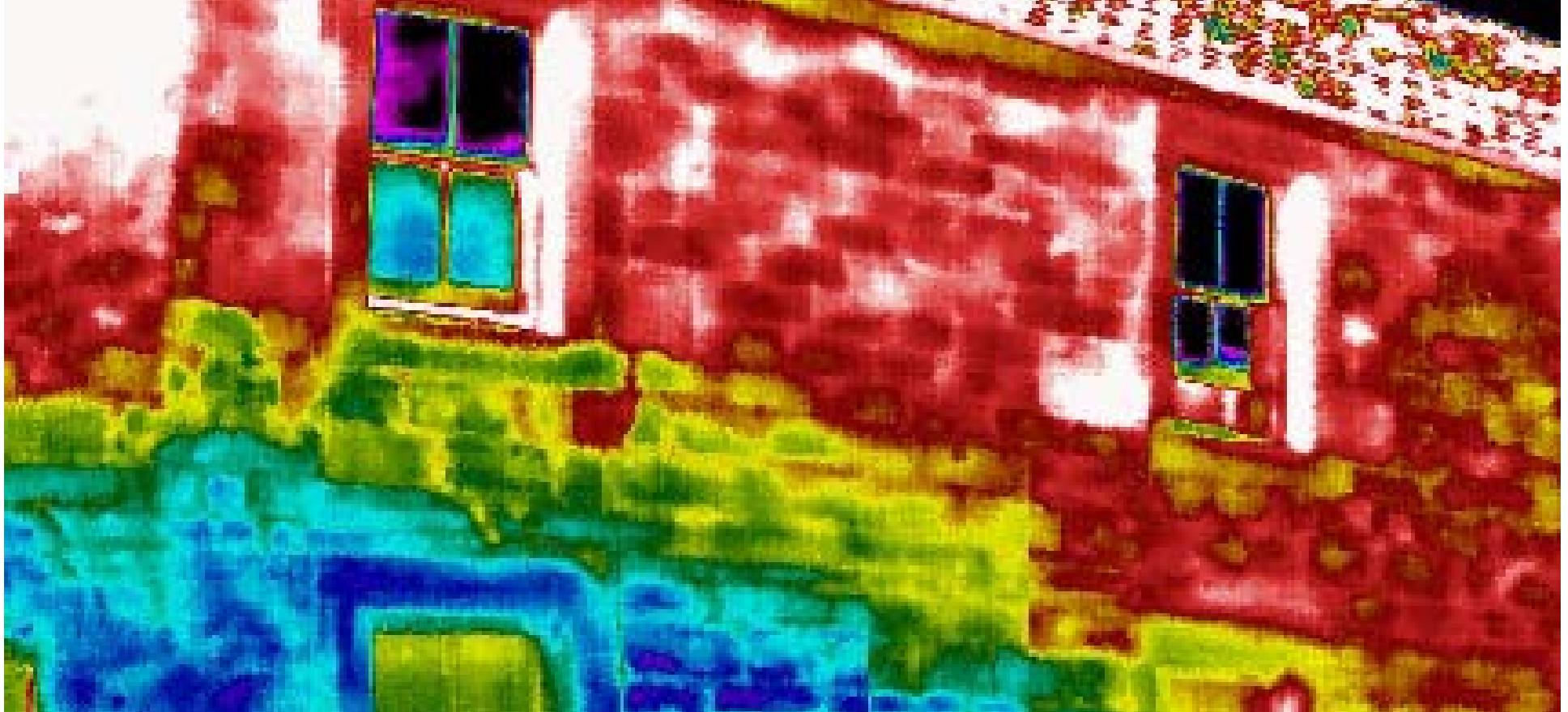


- Information on heat loss must be gathered at the right time of day – usually in the evening or night

- Buildings can be warmed externally by sunlight, as well as internally by heating

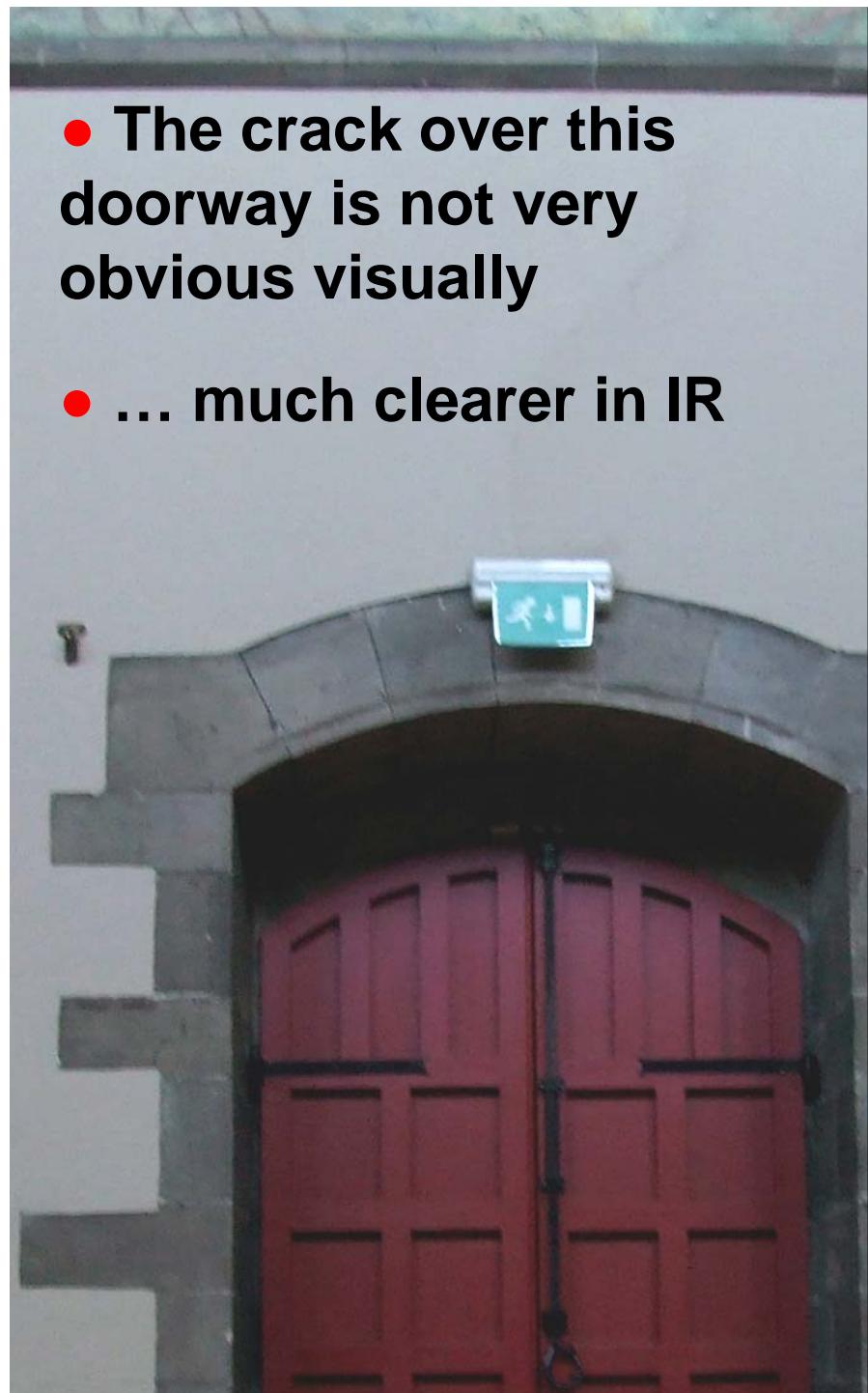
- You can't detect heat loss on a sun warmed facade





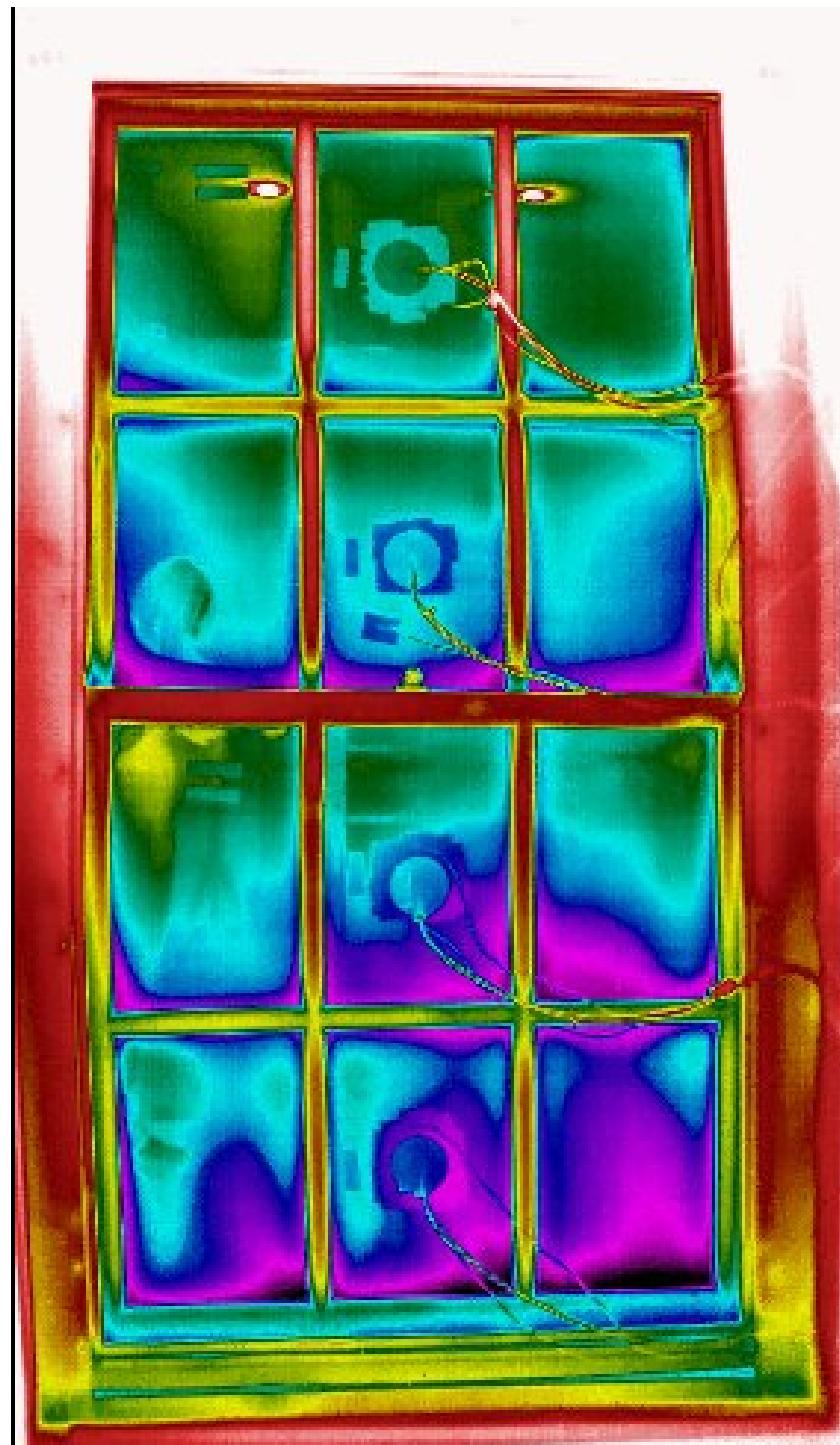
- This IR pattern is caused by the sun warming the upper part of the building

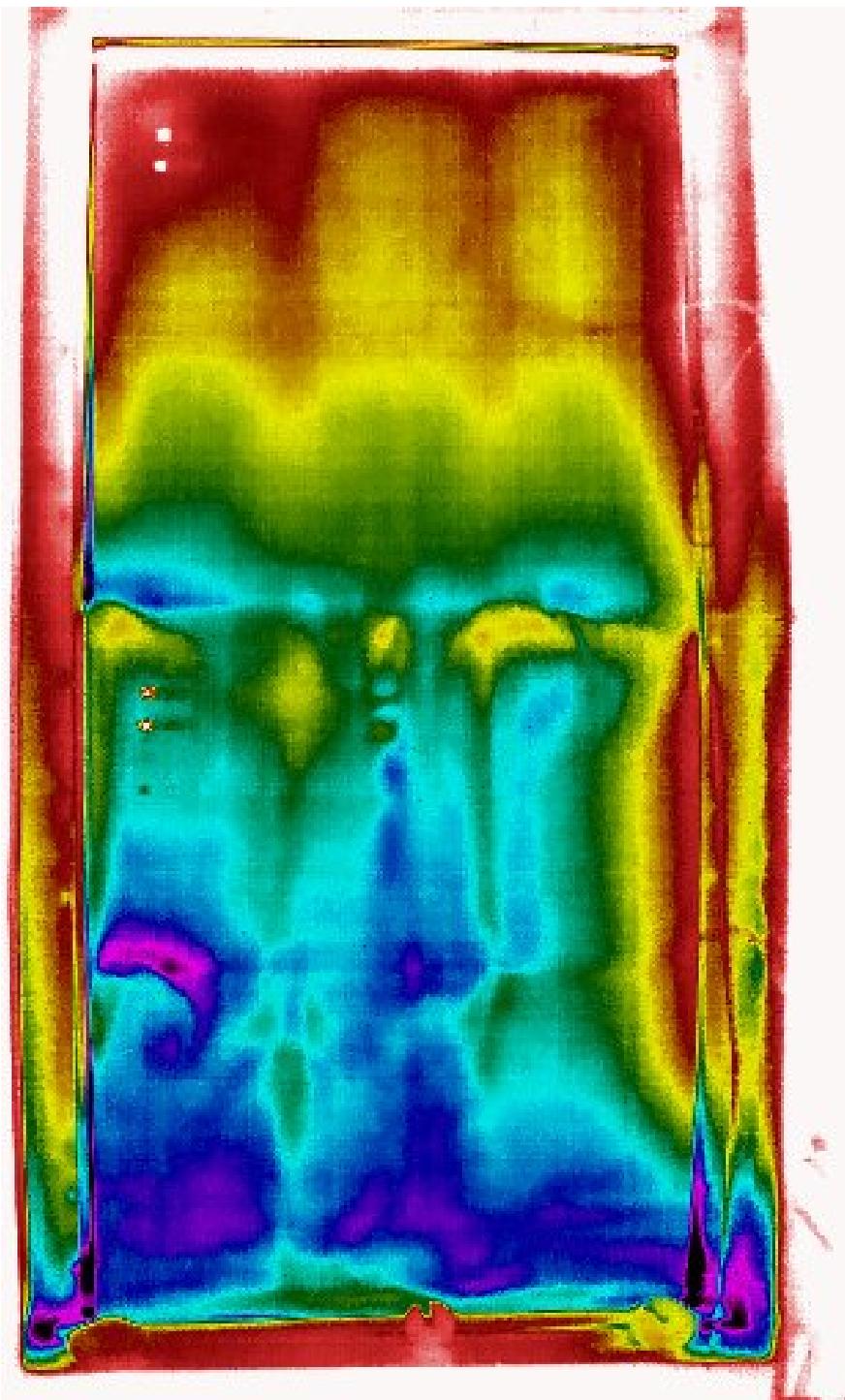
- The crack over this doorway is not very obvious visually
- ... much clearer in IR

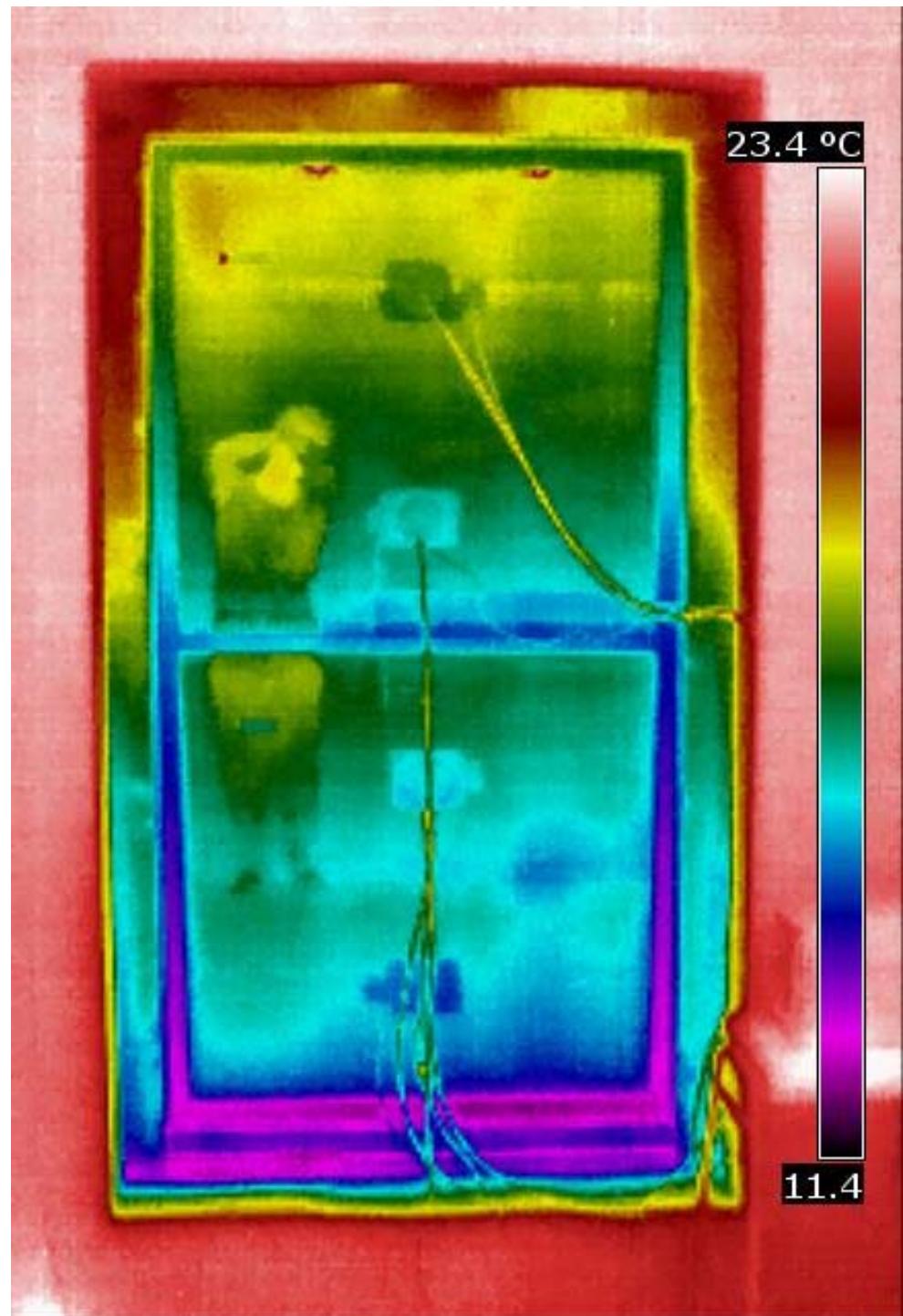


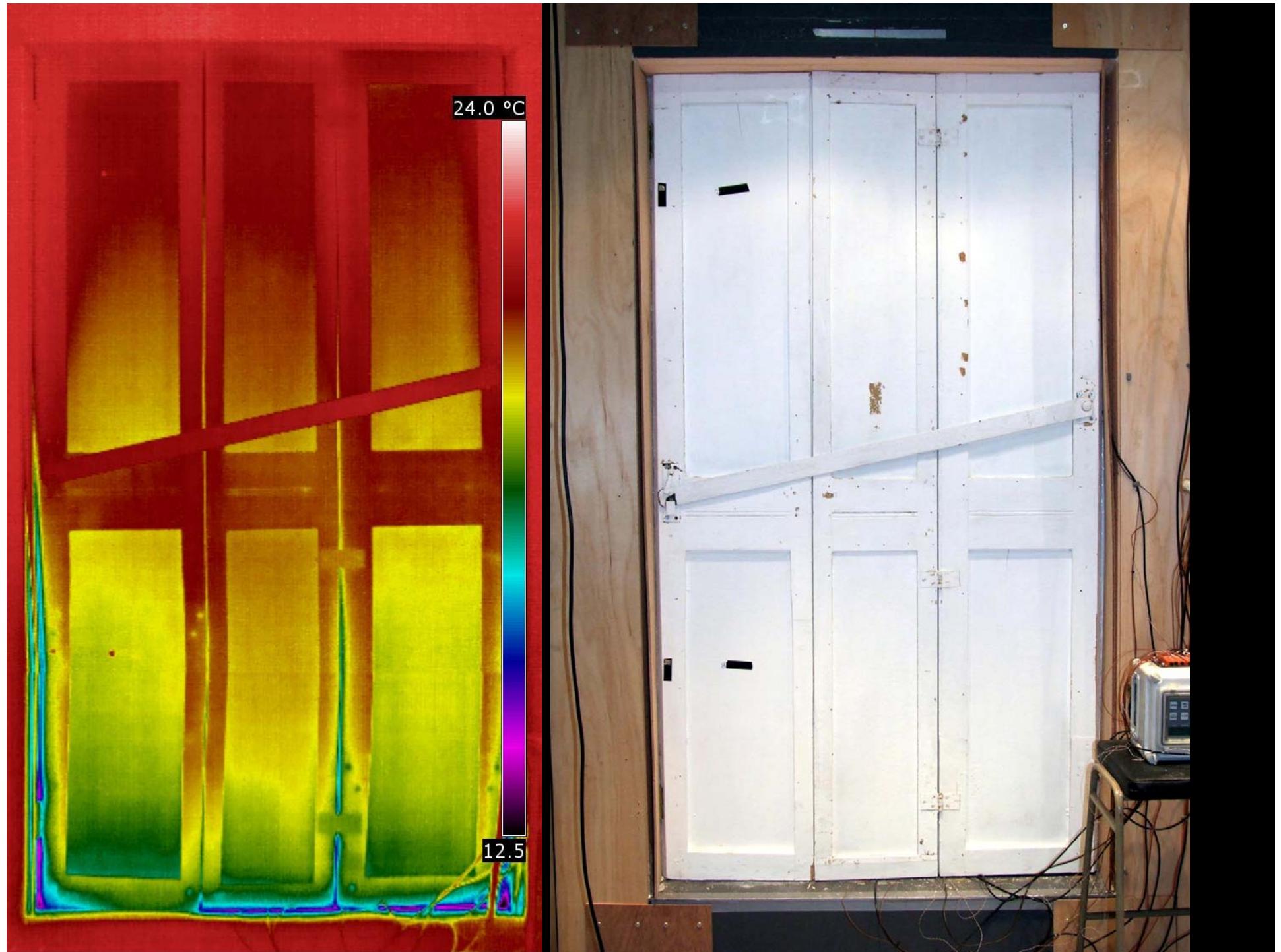


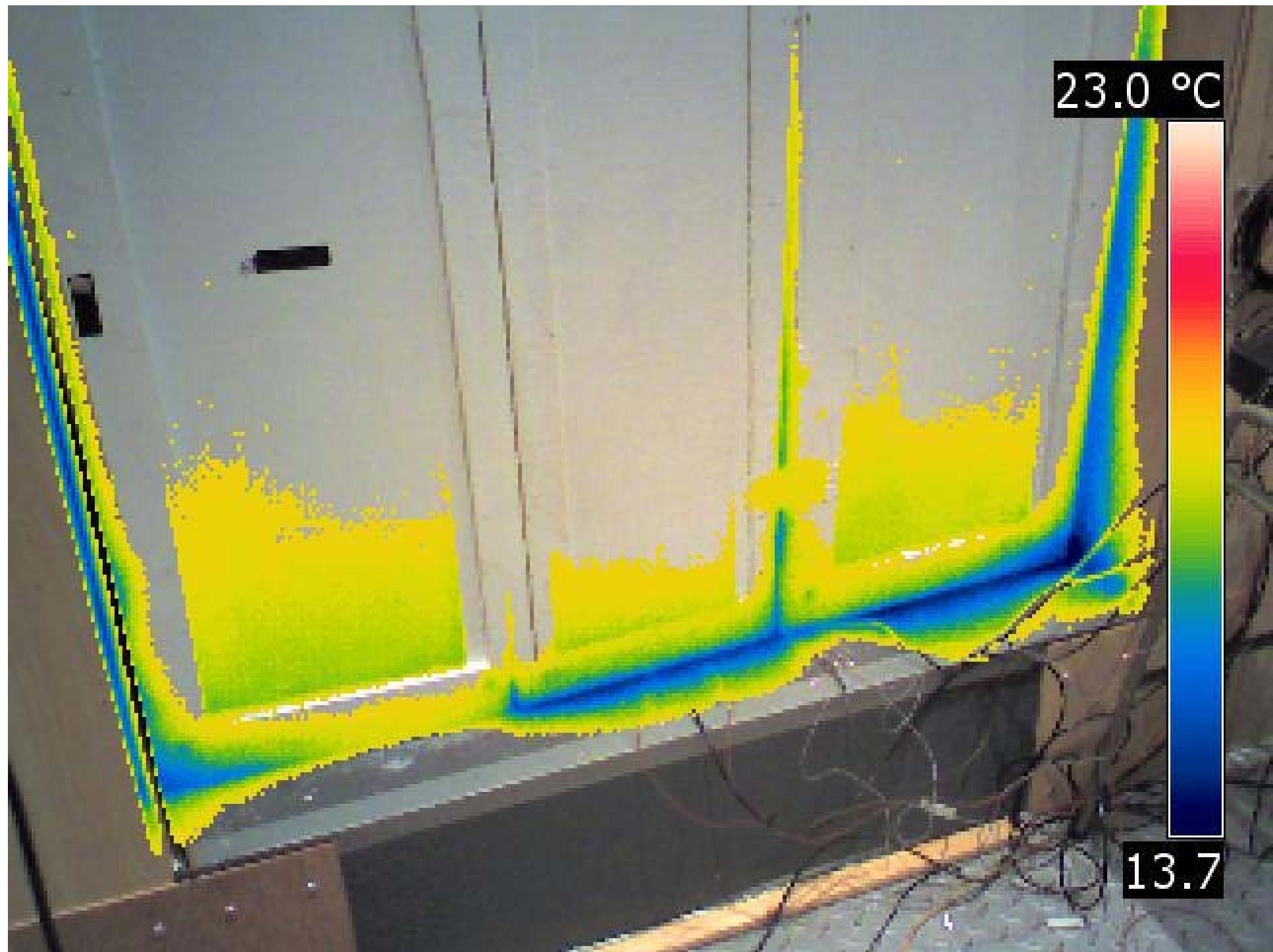
- There is a disused chimney somewhere around here...

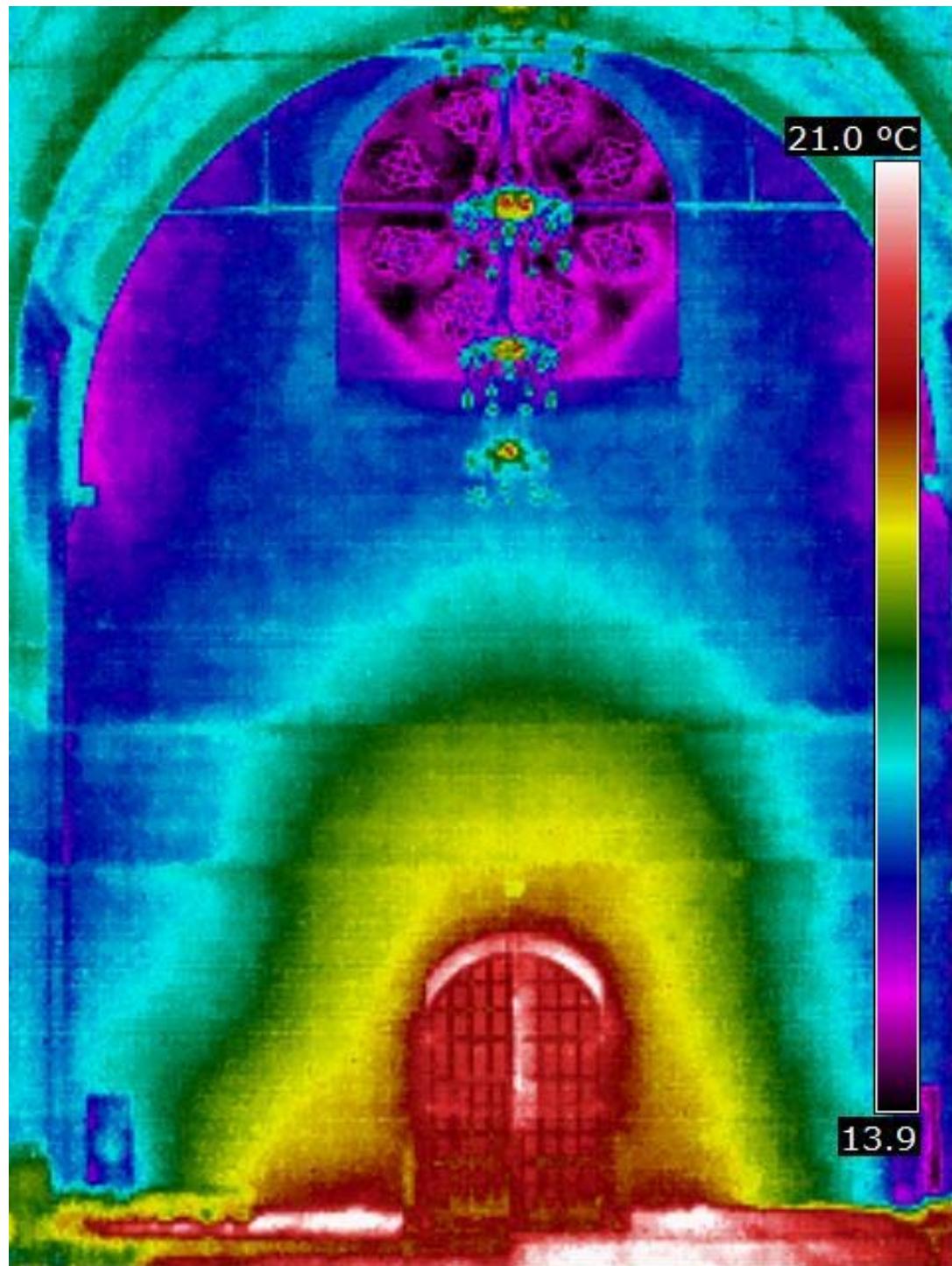












Thank you