CLIMATE AT THE EXTREMES CONFERENCE
Edinburgh, 6 September 2022

Beyond Space Heating and Cooling

CHANGING MINDSETS IN A CLIMATE AND ENVIRONMENTAL EMERGENCY

Bill Bordass

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Should we be resolving our problems,
or re-examining our premises?

"We can't solve problems
by using the same kind of thinking
we used when we created them"

Attributed to A EINSTEIN

"We are suffering from an attempt
to know our way into the future
instead of live our way"

W SHARPE

SOURCE: Bill Sharpe, *Three Horizons: the patterning of hope,* Triarchy Press (2020).

Beyond space heating and cooling

My ambition:

"a building with no heating, no cooling, and no lighting while the Sun is above the horizon"

MAX FORDHAM
1933-2022

In 2019, he very nearly did it >>>

Max Fordham House verified as net zero carbon

APRIL 25, 2022 / INDUSTRY NEWS

The UK's first net zero carbon residential home has been verified in line with the UKGBC's framework

A private house in Camden, built for pioneering engineer Max Fordham, has become the first residential building in the UK to be verified a completely net zero. *[Including offsets for residual embodied C].*

The RIBA award-winning house sets an example of how net zero homes can become a key part of the UK's housing solution. During his lifetime, Max Fordham made great efforts to change the way architects think about heating, power, and light, and constantly championing sustainable design.

SEE ALSO: https://www.maxfordham.com/news/max-fordham-house-becomes-the-uk's-first-net-zero-carbon-home

But what can we now do quickly *to be healthy and comfortable enough while saving energy in a hurry?*

FRAMING: People respond to Stories

Stories can alter radically … and then become taken for granted

OLDER STORIES *can persist, or revert*	**CURRENT STORIES** *C20-21*	**EMERGING STORIES ?** *Later C21*

"If current understandings of comfort underpin escalating energy demands, why persist with them?" **Comfort is socially and culturally determined**:

People's needs… have social histories of their own … The [mistaken] distinction between technology … and behaviour.

"Sociology … repeatedly demonstrates the extent to which things … 'script' what people do …

"[while] dominant paradigms remain … there are fewer references to non-technical barriers and more to sociotechnical change… practices not behaviours."

e.g. *Clothes like these could more than halve space heat demand:* ***Can we make them fashionable?*** **>>>**

SOURCE: E Shove, *Why social theory is important for energy research and the built environment,* Buildings & Cities (14 Sep 2020).

FRAMING COMFORT:
mindsets in earlier days

Pre-Enlightenment, texts mentioning comfort tended to be about spiritual aspects, *not creature comforts.*

Fires were largely used for cooking: *heating welcome but largely incidental.*

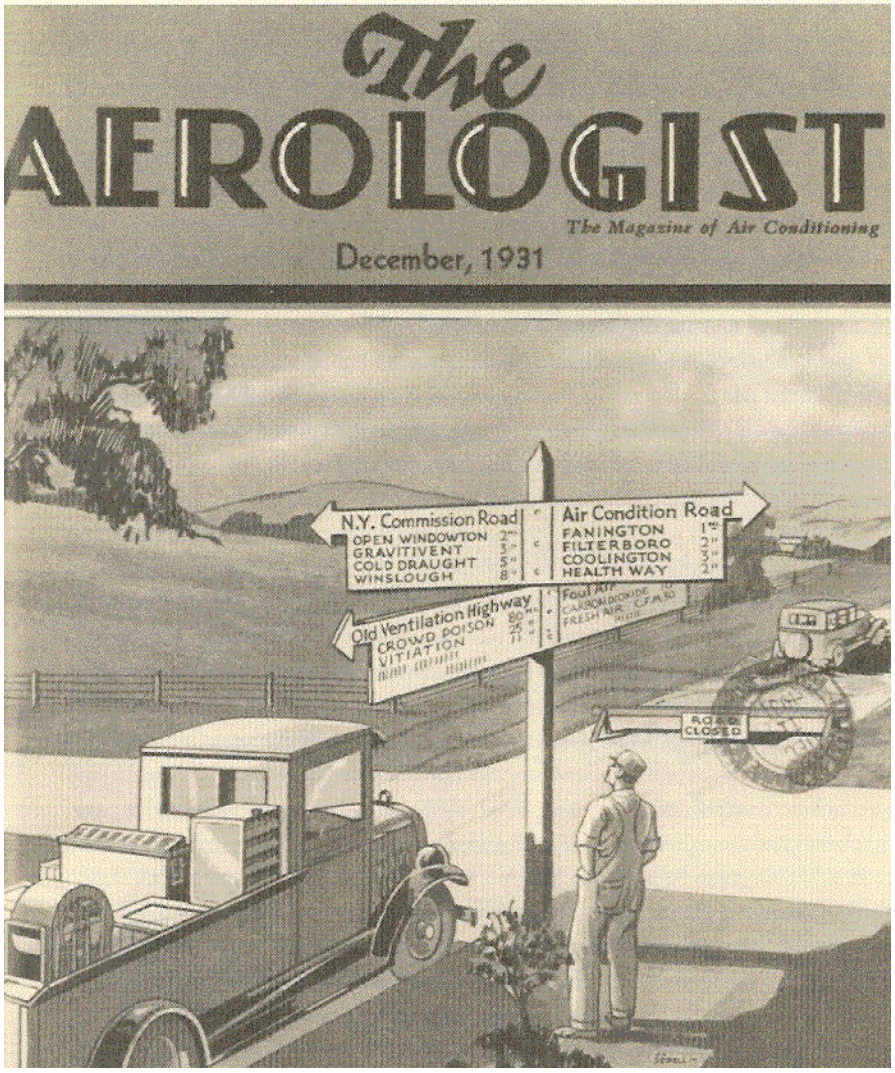
Expectations evolved alongside available resources and technologies, and following bursts of innovation. *viz UK Rumford fireplace, European ceramic stoves, American Franklin stoves …*

Mission creep over the years, enhanced by marketing,
so expectations for internal environments increased,
while some past practices were overlooked, and even forgotten.

BUT Ruling classes could regard physical discomfort as character-building, *viz British Public Schools.*

FRAMING COMFORT *in the 20th Century:*

Space conditioning was converted into a marketable commodity



"In 1922, the New York State Commission … advocated natural ventilation … The engineering community seriously opposed …

… "The Aerologist journal … argued physicians were stepping outside their [professional] boundaries.

"When natural climate was the ideal, mechanical systems were found wanting, but when quantitative standards … became the measure, natural climate was found wanting. When no town could deliver an ideal climate, all towns became potential markets."

AND AFTER WORLD WAR 2:

Climate-responsive features of buildings (verandahs, shutters, shade roofs etc.) were simplified or eliminated, in order to make air conditioning more affordable.

SOURCE: G Cooper, *Air-conditioning America,* Johns Hopkins University Press (1998), pages 69-79 and cover illustration.

Comfort and discomfort in context
on a simplified scale

-
-
-
-
- **Neutral** *(comfortable)* – ***Typical aspiration*** *(but sensory deprivation?)*

SOURCE OF ILLUSTRATION: Cover of L Heschong, *Thermal Delight in Architecture,* MIT Press (1979)

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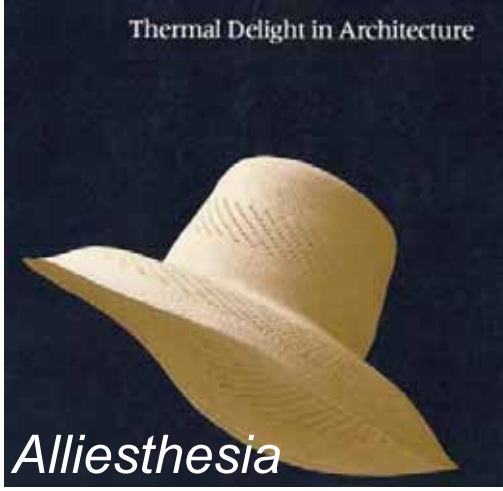
on a simplified scale



- Acute medical problems *(e.g. heat stress, frostbite)*
- **Discomfort** and stress *(too much of a good thing)*
- Delight *(exhilarating stress: theatre, beach, skiing)*
- Comfortably unbalanced *(e.g. comfortably warm or cool)*
- **Neutral** *(comfortable)* – ***Typical aspiration*** *(but sensory deprivation?)*
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CRISIS OF DISCOMFORT *(comes sooner if one lacks perceived control)*

- Irritably uncomfortable
- Increasing discomfort, until …
- Acute medical problems *(heat stroke, hypothermia)*

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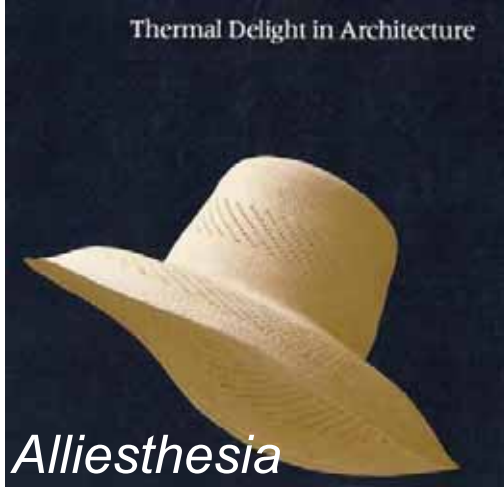

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People don't need heating or cooling

BUT heat gains and loss must not be so high that our physiology can't keep core body temperature under close control AND take care to avoid chronic health issues, e.g. from damp and mould.

SOURCE OF ILLUSTRATION: Cover of L Heschong, *Thermal Delight in Architecture,* MIT Press (1979)

FRAMING COMFORT *in a Climate Emergency:*

How about seeking to escape ***Crises of discomfort*** *

HOW?

Use perceived control & adaptive opportunity, e.g:

- Adjust a passive system *(windows, blinds etc).*
- Adjust M&E services *(central, local or personal).*
- Contact the manager *(but rapid response is vital).*
- Adjust posture, clothing, activity etc. *(+ lap dogs and hot water bottles)*
- Move about, go somewhere else, go outside *(possible at home, in some modern work environments, in Australia! …).*
- Eat or drink *(hot or cold), take a shower, feet in bucket* …

Loose control with adaptive opportunity can give greater occupant satisfaction with less energy dependency …

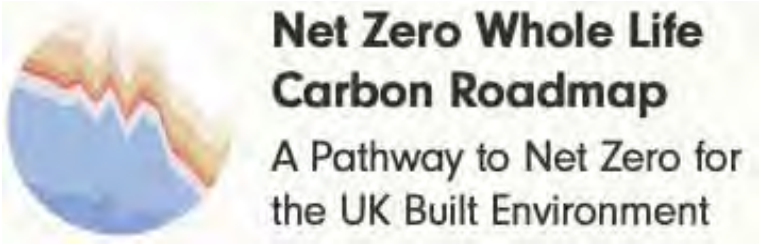
***BUT** achieving consensus in shared spaces can be tricky.*

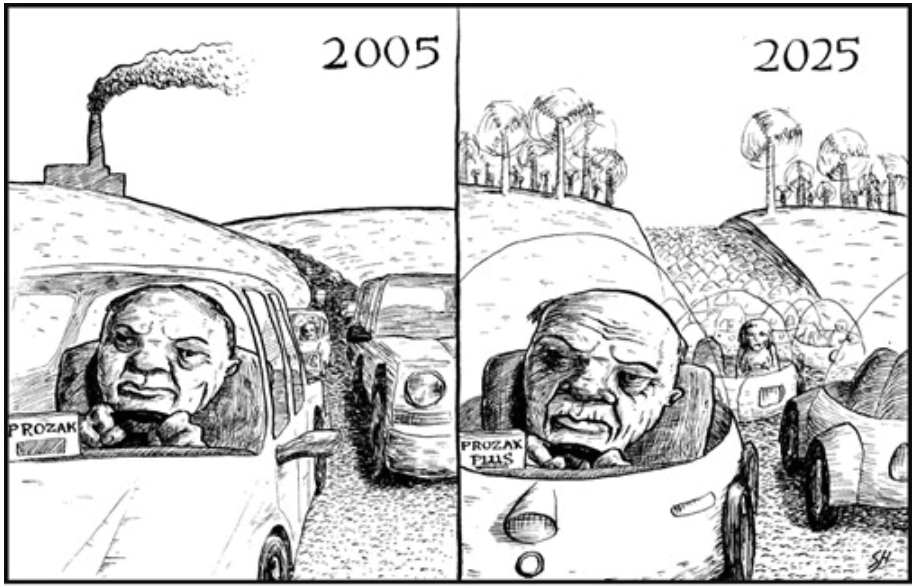
* SOURCE: D Haigh, *User response in environmental control,* in D Hawkes & J Owers (ed), *The architecture of energy* (1981).

So which frame might this have come from?

Current Story or Emerging Story?

"The opportunity for widespread behaviour change has been considered, with a cautious approach to expectations that occupants will be able to reduce thermostats without improvements to building fabric."





The technofixers' best-case scenario

SOURCE: *Net Zero Whole Life Carbon Roadmap,* UK Green Building Council report (2021).

ENERGY SUFFICIENCY: *Avoid unhealthy environments, allow escape from crises of discomfort*

MAIN METHODS:

1. Review appropriate standards *and promote adaptive comfort*
2. Control draughts, air movement and radiant heat gains and losses
3. Wear the right clothing and have suitable furniture etc.
4. Consider local and personal heating and cooling systems
5. Have accessible, responsive user-friendly controls
6. Improve thermoregulatory fitness where practicable
7. ADD thermal refuges, *both hot and cold, local and communal.*

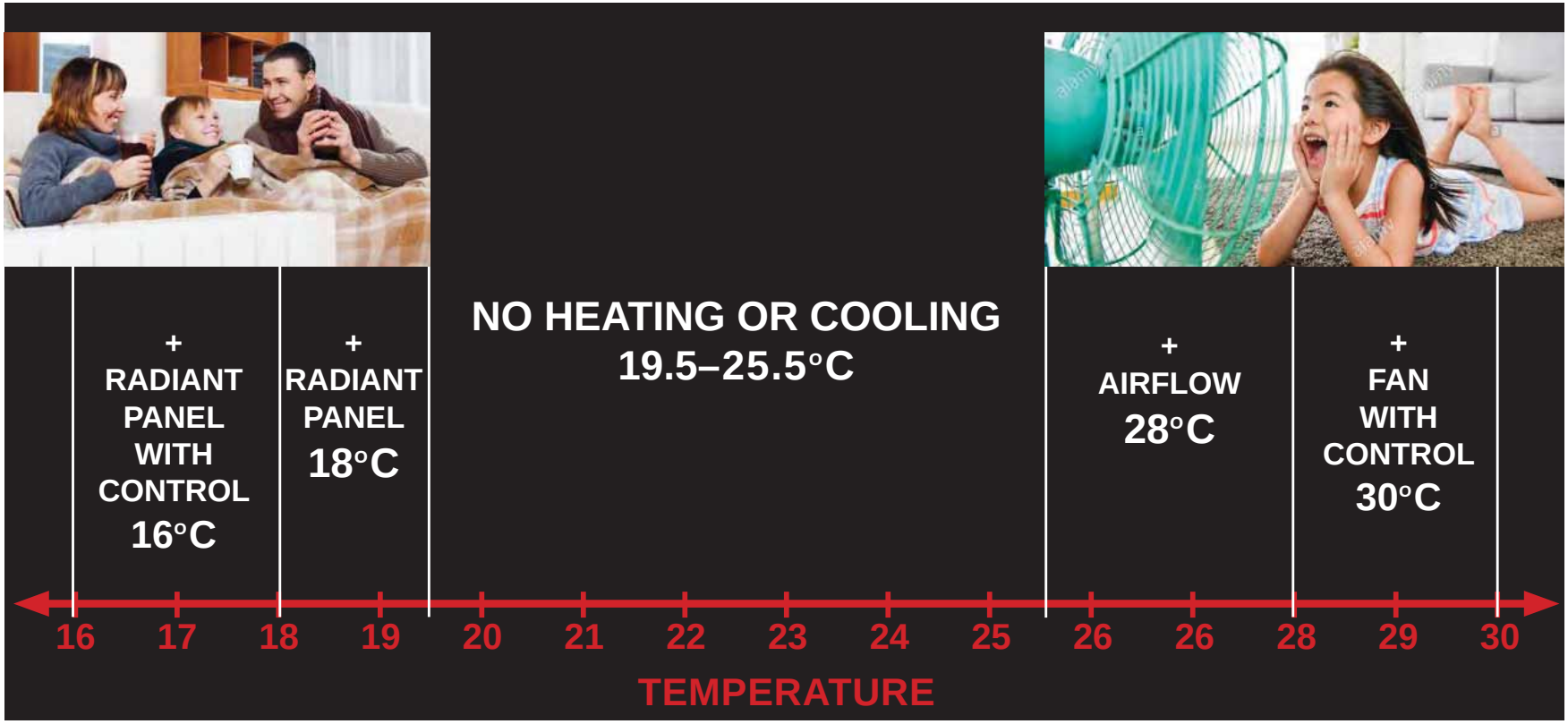
"He gets so dramatic when I lower the thermostat."

These also save energy and carbon much more quickly and cheaply than heavy capital investment.

P C Vey cartoon from the New Yorker (1 April 2019).

1. STANDARDS: *Are they fit for today?*

What do we really need to heat and cool spaces to?



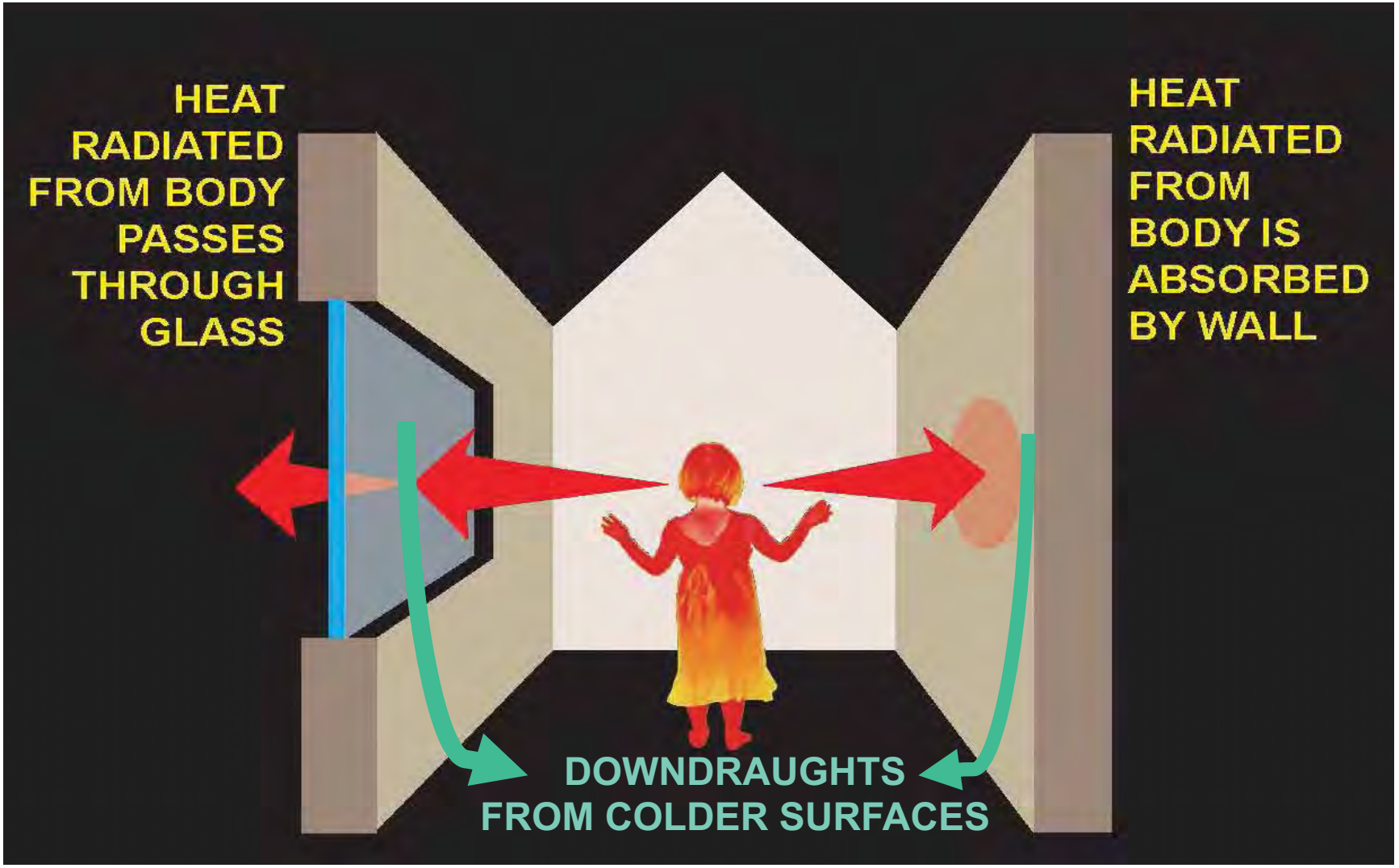
What about UK's recommended minimum 18°C Health requirement?

In its Minimum Home Temperature Thresholds review (2014) Public Health England says it is a *"weak recommendation"* with little robust support, but *may be beneficial to the over-65s and those with pre-existing medical conditions.*

SOURCE: R Pender (2019) after G Brager, *Evolving opportunities for providing thermal comfort,* Building Research & Information **43** 274-287 (2015).

2. DRAUGHTS & RADIATION:

Effects of relatively cooler surfaces



ADAPTED FROM: Robyn Pender, Historic England, *Lecture to the Rumford Club* (20 Feb 2020).

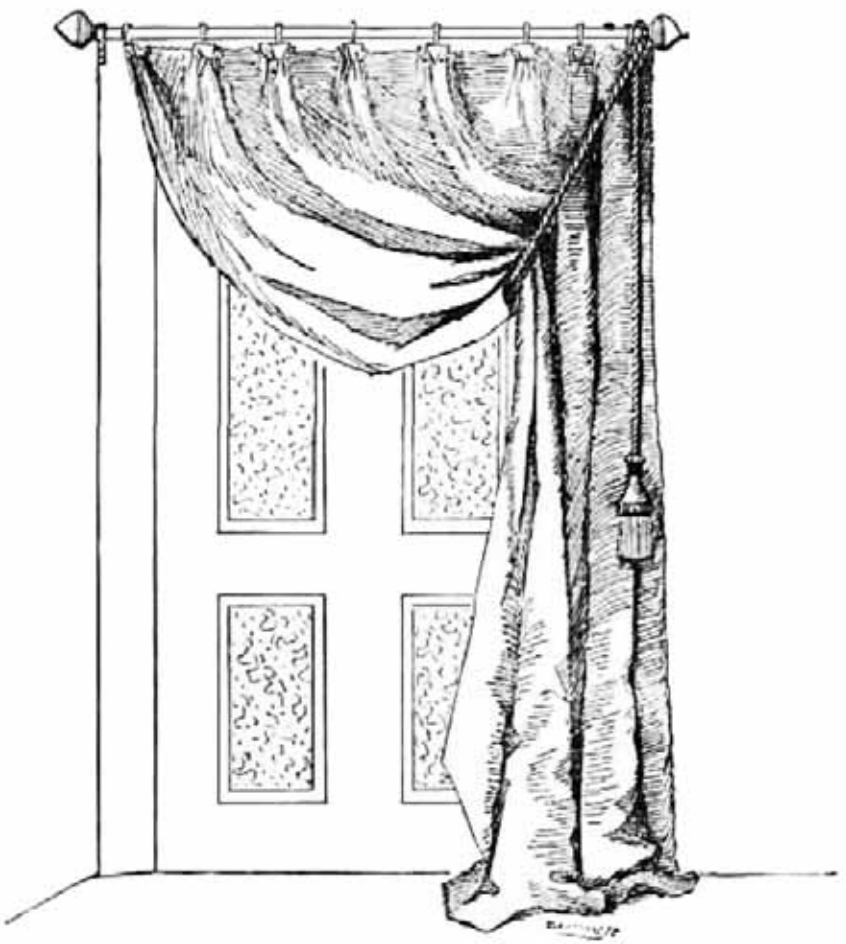
2. DRAUGHTS & "COLD" RADIATION:

Rich and poor could both have wall hangings

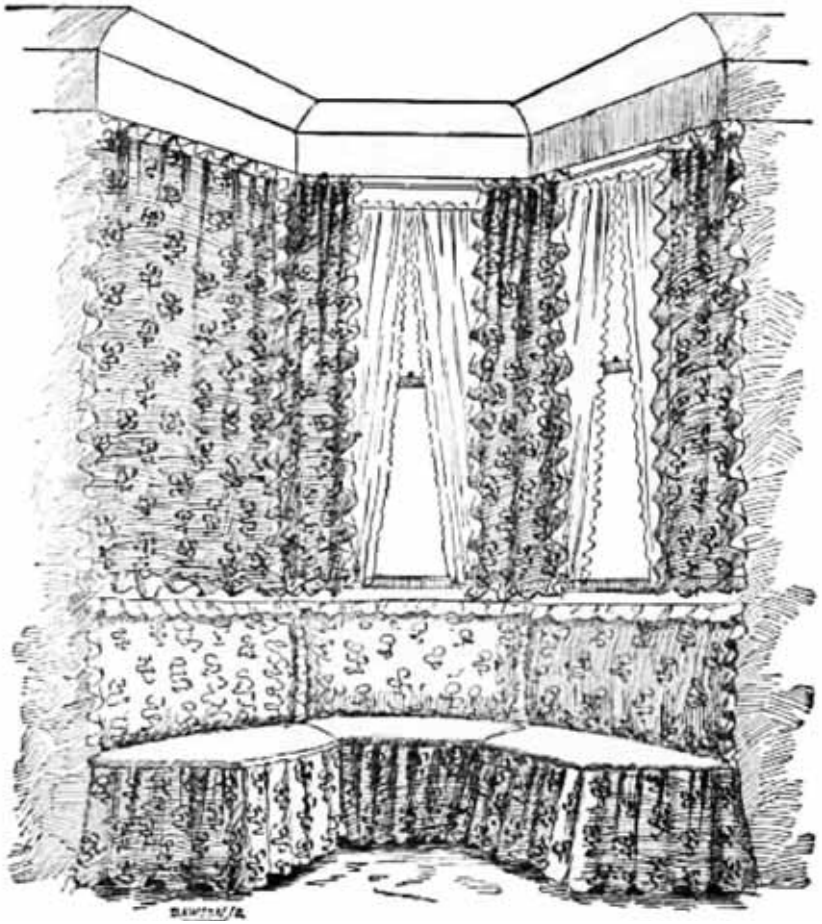
SOURCE: Robyn Pender, Historic England, *Lecture to the Rumford Club* (20 Feb 2020).

2. DRAUGHTS & "COLD" RADIATION:

Victorian soft furnishings were partly for thermal reasons



"This [cord] allows the curtain being dropped in one moment should more warmth be desired."



"[the male architect]… too many windows … and almost ruins us in blinds and curtains"

SOURCE: J E Panton, *From kitchen to garrett: Hints for young householders,* Ward & Downey (7th Edition 1890).

2. DRAUGHTS & RADIATION:

Simple ways of countering losses and gains

Traditional Orkney high-backed chair with drawers for whisky and a Bible.

Ad hoc external shading by old linen sheets during 2022 London heatwave kept peak internal temperatures below 27 C.

3. CLOTHING: Back to the Future *in a chateau*

Modern winter layers – awkward indoors and ultimately not warm enough

An Erasmus-style hat is comfortable and warm

Late medieval Burgundian coats – finally warm enough!

Cone-shaped mediaeval garments proved to be the warmest and most controllable

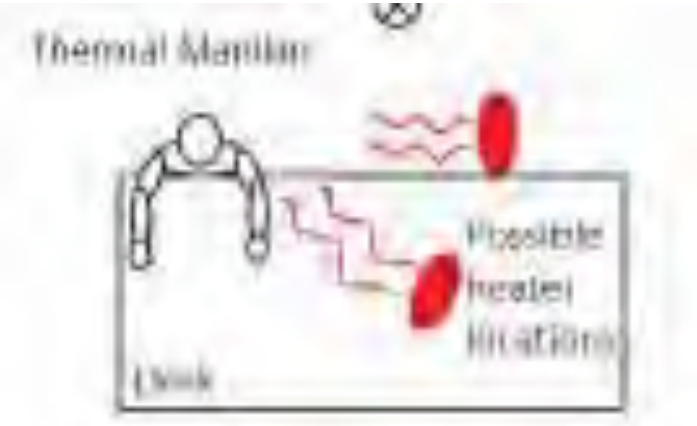
Heating one 40 m^2 room to 10-15°C with a log fire needed less than 5% of the fuel required to heat the whole building to the high teens using modern wood burning stoves.

SOURCE: J Parker, *Returning to old ways of staying warm,* (2016), www.traditioninaction.org/Cultural/C042_Warm.htm

4. LOCAL AND PERSONAL HEATING:
Experiments with 16-zone thermal manikin

Indicative Watts to increase personal comfort by 1°C:

250	Local convector heater
100	Local radiant panel
35	Local foot warming mat
<10	Heated chair or cushion



* S Kohn, *Development of a Personal Heater Efficiency Index,* MSc Thesis, University of California, Berkeley (2017).

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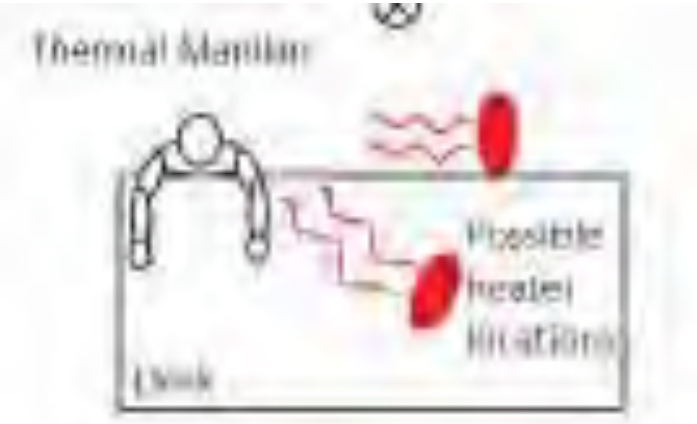

Max heating power 14 W
Max cooling power 3.6 W

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5. USER-FRIENDLY CONTROLS

"In a Machine for Living, I want to be in the driving seat" – OCCUPIER

"We sell dreams and install nightmares" – CONTROLS MANUFACTURER

THE RUNBACK TIMER:

The most neglected control?

perhaps no longer … ?

PEOPLE ARE THE BEST JUDGES OF WHAT THEY WANT … BUT

YOU CAN NEVER HAVE TOO MUCH OF A GOOD THING

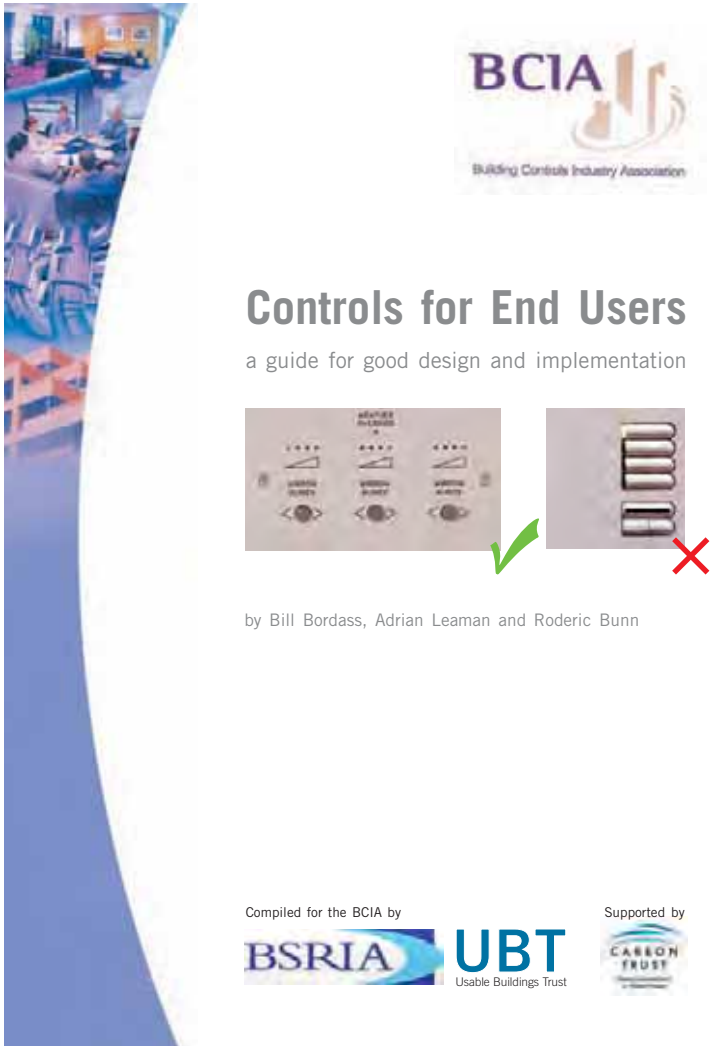
5. USER-FRIENDLY ROOM CONTROLS

A few principles for both passive + active systems

- **Easy to reach**
  from the point of need
- **Easy to use** and understand,
  and preferably intuitively obvious
- **Acknowledge interventions**,
  so you know things are going to happen
- **Default to off**, safe or standby,
  so energy isn't wasted.

PLUS Rapid system response:
Widens thresholds of acceptability, by lessening any anxieties that conditions might continue to deteriorate. Conversely, slow or no response narrows thresholds for a "crisis of discomfort".

BUT People are not good at anticipation:
advice, decision support, or backup (e.g. mixed mode) systems may be needed.



SOURCE: B Bordass, A Leaman & R Bunn, *Controls for end users,* Building Controls Industry Association BCIA (2007)

6. THERMOREGULATORY FITNESS

*Improving one's personal thermal physiology**

- **Habituation** to uniform thermal environments
  has reduced our thermoregulatory capacity to cope with temperatures outside the range of conditions we normally experience.

- **We CAN be more resilient**.
  Acclimatisation has been shown to improve the ability to regulate body temperature in young, middle-aged and overweight individuals.

- **This will require "temperature training"**
  More thermal variation in everyday life will improve cardiovascular and metabolic health, save energy, and help us adapt to climate change.

BUT *We will still need to protect ourselves*
(and particularly vulnerable individuals) from the hazardous effects of thermal extremes and other health issues.

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* POINTS SUMMARISED FROM: H Pallubinsky *in Physiology and climate change,* The Physiological Society, 19-21 (2021).

7. REFUGES

both local and communal

JAPANESE KOTATSU HEATED TABLE.
Also used in Middle East and WW1 trenches.
Traditionally charcoal. Often electric today.

PUBLIC REFUGE IN PORTLAND, OREGON
During the “heat dome” temperature extreme
in late June 2021.

See also Sue Roaf on Cool and Cosy Corners in dwellings, viz https://www.ft.com/content/b3855b41-6476-44b8-a17c-8a5448fe13a0

RECAP
Beyond space heating and cooling

"Evening out fluctuations has become an egalitarian enterprise which it is heresy to question." - MICHAEL YOUNG

1. Challenge standards
2. Control draughts/breezes and radiant gains and losses
3. Effective clothing, *make it fashionable too.*
4. Local and personal heating *and appropriate furnishings*
5. Responsive, user-friendly controls, *default to off or safe*
6. Improve thermoregulatory fitness: *use it or lose it!*
7. Thermal refuges, *local and communal*

AND

8. Plan to avoid health-related unintended consequences.

MICHAEL YOUNG, *The Metronomic Society: Natural Rhythms and Human Timetables,* Thames & Hudson (1988) .

AFTERWORD: *Evolving Mindsets*

PAST *can persist, or revert*	**PRESENT** *C20-21*	**FUTURE?** *Later C21*
SUBJECT *of a Chief, King, Pope, Dictator, Putin …*	**CONSUMER** *I spend, therefore I am*	**CITIZEN** + COMMUNITY *both local and wider scales*
PRIESTHOODS *+ Guilds Professions Unions*	MARKETS: *Invisible Hand, or Corporate Takeover?*	COLLABORATIVES *with diverse skills*

Subject-Consumer-Citizen classification from: J Alexander & A Conrad, *Citizens,* Canbury Press, Kingston (2022).

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BUILDINGS: BUILT TO LAST, Robust *With routine maintenance*	BUILT TO CONSUME *Demolish or retrofit old ones*	IMAGINATIVE RE-USE *Improving what we've got*
COMFORT: LOCAL PROVISION *& Thermoregulatory Fitness*	SPACE CONDITIONING *Commoditised comfort*	RESILIENCE, AVOIDING CRISES of DISCOMFORT plus Thermal Adaptation
ENERGY: CONSERVATION *Husbanding resources*	EFFICIENCY *But not necessarily saving*	SUFFICIENCY *Living within our means*

"… we are living the end of what could have seemed an era of abundance … of products of technologies that seemed always available … of land and materials including water" - EMMANUEL MACRON, 23 Aug 2022

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ENERGY: CONSERVATION *Husbanding resources*	EFFICIENCY *But not necessarily saving*	SUFFICIENCY *Living within our means*
RESEARCH: BASIC *And on-the-job learning*	ACADEMIC *Distanced from practice*	REAL-WORLD *Closely integrated with practice*

SEE: H Robson, *Real-World Research.* Butterworth-Heinemann (1993 et seq). 5th Edition upcoming, Wiley (2023).

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		ENERGY: SUFFICIENCY *Living within our means*
		RESEARCH: REAL-WORLD *Closely integrated with practice*

"You don't waste time with reactionaries; rather you work with active change agents and with the vast middle-ground of people who are open minded" - DONELLA MEADOWS *

* Donella Meadows and Dianne Wright, *Thinking in Systems,* Chelsea Green Publishing (2008) page 4.

THANK YOU

Questions?

"C'mere, space heater."

'Faster! The lights are dimming'

www.usablebuildings.co.uk