

HEATING AND VENTILATION
(RECONSTRUCTION) COMMITTEE OF THE
BUILDING RESEARCH BOARD

TO THE BUILDING RESEARCH BOARD.

GENTLEMEN, We, the Heating and Ventilation (Reconstruction) Committee, beg leave to present a Report on the Heating and Ventilation of Dwellings, giving the results of the consideration which we have given to the subject following our appointment in July, 1942, with the following terms of reference:

- i. To review existing scientific information and practice in this country and abroad on the heating and ventilation of buildings.
- ii. To make recommendations for practice in post-war building, regard being had both to economy and efficiency for the individual user and to the economical utilization of the national fuel resources.
- iii. To make such recommendations for further research as may suggest themselves in considering (i) and (ii).

We have had six meetings in full Committee, taking as our first task the problem of the heating and ventilation of dwellings, in accordance with the order of priority which was suggested to us. At our first meeting, we received, as a basis for the consideration of the heating of dwellings, a statement of information assembled by a Departmental Group comprising members of the staffs of the Building Research Station and Fuel Research Station, together with Sir Alfred Egerton (Chairman), Mr. J. H. Markham, Mr. W. W. Nobbs, and Mr. A. C. Pallot. This Group had for some time been conducting inquiries into the subject, and it has continued to meet during the course of our deliberations, giving us much assistance. The Group suffered a great loss by the death in January 1943 of Dr. F. S. Sinnatt, Director of Fuel Research, who had taken a very great interest in the work.

In the first instance, we arranged for the statement to be considered separately by sections of the Committee, each consisting of members having specialized experience in particular directions—for example, on heating by solid fuel, by gas, or by electricity, or in the general field of heating and ventilating engineering. Subsequent to this first examination of the statement, those members specially conversant with the problems of heating by each of the different fuels, together with some other members of the Committee, have collaborated in a more detailed consideration of the subject, and for this purpose they have held a number of informal meetings. They wish to place on record the great value of the exchange of views which took place at these meetings and of the mutual co-operation thus established.

The subject of domestic heating (including water heating and cooking) is a complex one, for among the many factors which have to be taken into account in reaching a decision on the type of heating to be employed are the very different requirements and preferences of different families, the variety of appliances or combinations of appliances which are available, and the relative costs of the different fuels in various localities. All these factors intimately affect the householder. From the standpoint of the nation as a whole, as distinct from that of the individual, certain considerations affecting the wisest use of our national coal resources have also to be taken into account.

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There is thus no single answer to the question "What is the best system of heating for domestic purposes?" Even taking things as they stand to-day, a great deal depends on circumstances; and looking towards the future, the trend of practice must inevitably be influenced by developments in the fuel industries themselves, the nature of which cannot be predicted, so that the arrangements made must be sufficiently flexible in order to take advantage of these developments. We have taken the view, therefore, that the best service which we could render was to set down a basis on which decisions in particular cases could be arrived at, by discussing the various factors which need to be taken into account, rather than to suggest what the decisions should be. With that in mind, we have proceeded, after a general introduction (Chapter 1), firstly to set out the average conditions of warmth and ventilation which are desirable, and the minimum provision for hot-water supply and cooking (Chapter 2); secondly to find the amount of heat theoretically needed in an average house to provide these basic facilities and how this amount is affected by the construction of the house, the layout of the hot water system, etc. (Chapters 3 and 4); and thirdly to discuss the various factors relating to the choice of methods of heating (Chapters 5-7). The ventilation of dwellings is dealt with in Chapter 8, and the special conditions of rural housing are also discussed (Chapter 10). Certain other matters incidental to the main theme, including clothes washing (Chapter 9), foreign practice (Chapter 11), development in appliances, and their installation and use (Chapter 12), the testing of appliances (Chapter 13), and the use and distribution of fuel (Chapter 14), are also considered. The report of the Inquiry into the Heating of Dwellings, undertaken by the Wartime Social Survey, forms Appendix 1. A number of other appendices, supplementing or amplifying information in the body of the Report, have also been included: one of them briefly surveys the subject of atmospheric pollution in relation to domestic heating.

Although we have decided unanimously to submit the present Report, it should be explained that every opinion expressed is not necessarily that of every individual member. For example, the standards of heating set out in the Report are considerably higher than were customary in the past, and some of us feel that they represent more than what most people would be able or willing to pay for, and that they would lead to needless consumption of coal, our resources of which have to be conserved. Attention is particularly drawn to the qualifications in paragraphs 2.1.9, 2.3.1, 3.1.2, 3.1.3.1, 6.2.3, 7.2.2.4, and 7.2.4 in the Report.

As has been stated, we considered first the heating and ventilation of dwellings, as it is this branch of the subject which most needs attention, for the heating and ventilation of large buildings is usually entrusted to heating engineers, and the examination of the merits of different schemes for different circumstances is on a well-established basis. But while the Report is primarily directed to domestic premises, some parts of it are of more general application. Statements on the heating of schools and on the heating of buildings other than houses and schools have been prepared by the Department Group already mentioned, but we have not yet completed our consideration of them, so that our Report on these subjects will follow separately.

In view of the developments abroad on district heating, we have thought it desirable to arrange for an examination of the technical merits of the case for the wider adoption of such district heating schemes in this country. At our second meeting a special Sub-Committee was appointed with the following terms of reference:

"To inquire and report on the desirability of developing in this country schemes for the supply of heat for various purposes by means of steam or hot water from central sources."

The Sub-Committee is making a thorough examination of the subject, and its report is not yet available.

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We suffered a great loss by the death of Mr. Stephen Lacey, whose work for the Committee had been invaluable. We were sorry too, when Sir David Milne-Watson found it necessary to resign owing to pressure of other work.

We should also like to acknowledge the valuable assistance given by Mr. C. C. Handisyde in his capacity as Secretary from the inception of the Committee until October 1943, and by Mr. N. S. Billington who then undertook these onerous duties.

We should like to emphasize that we were appointed in our personal capacities, and the Report does not purport therefore to express the views of any of the organizations with which individual members may be connected.

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DEGREE-DAY : A unit based upon the temperature difference and time, used in specifying the nominal heating load. For any one day there exist as many degree-days as there are degrees Fahrenheit difference in temperature between the average outside air temperature over a 24-hour period, and a temperature, known as the "base temperature," depending on the temperature to be maintained within the building when the outdoor temperature is below the base temperature. The base temperature is assumed to be 5° F. lower than the maintained temperature. Except where otherwise stated, the annual total of degree-days for all the days of the year is to be assumed. For the normal degree-day in Great Britain, the base temperature is 60° F.

AIR CHANGE : The rate of air change in a room is the ratio of the actual volume of air entering the room per hour to the volume of the room.

EQUIVALENT TEMPERATURE of an environment is that temperature of a uniform enclosure in which a black cylinder of height about 22 in. and diameter about 7½ in. would lose heat at the same rate as in the environment under consideration, the surface of the cylinder being maintained at a temperature which is a precise function of the heat loss from the cylinder and which in any uniform enclosure is lower than 100° F. by two-thirds of the difference between 100° F. and the temperature of the enclosure.

RELATIVE HUMIDITY : If x is the partial pressure of the water vapour present in moist air, and f is the partial pressure of the water vapour in saturated air at the same temperature, the percentage relative humidity is :

$$r = 100 \frac{x}{f}$$

EFFICIENCIES of appliances, etc. See Chapter 6.

BACKGROUND HEATING : The maintenance of a minimum temperature in a room throughout the 24 hours, this minimum temperature being generally below the temperature required for sedentary occupation.

TOPPING-UP : The provision of extra heat to bring a room to a comfortable temperature during periods of occupation.

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APPENDIX 7

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"H. of D. Inquiry" stands for "Heating of Dwellings Inquiry."

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TERMS OF REFERENCE

- i. To review existing scientific information and practice in this country and abroad in the heating and ventilation of dwellings.
- ii. To make recommendations for practice in post-war building, regard being had both to economy and efficiency for the individual user and to the economical utilization of the national fuel resources.
- iii. To make such recommendations for future research as may suggest themselves in considering (i) and (ii).

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M.I.H.V.E.

W. Holford, B.Arch., A.R.I.B.A.

H. J. Manzoni, C.B.E., M.Inst.C.E.

W. W. Nobbs, M.I.Mech.E.,
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A. C. Pallot, M.B.E., B.Sc.(Eng.),
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Sir Leonard Pearce, C.B.E., D.Sc.,
M.Inst.C.E., M.I.E.E., M.I.Mech.E.

R. N. Quirk.

W. M. Selvey, Wh.Sc., M.Inst.C.E.,
M.I.Mech.E., M.I.E.E., F.Inst.F.

Sir Johnstone Wright, M.Inst.C.E.

H. E. Beckett, *Secretary*.

TERMS OF REFERENCE

To inquire and report on the desirability of developing in this country schemes for the supply of heat for various purposes by means of steam or hot water from a central source.

MINISTRY OF WORKS

POST-WAR BUILDING STUDIES

1. HOUSE CONSTRUCTION

By an Inter-Departmental Committee appointed by the Minister of Health, the Secretary of State for Scotland and the Minister of Works.

2. STANDARD CONSTRUCTION FOR SCHOOLS

By a Committee appointed by the President of the Board of Education.

3. PLASTICS

By a Committee convened by The British Plastics Federation.

4. PLUMBING

By the Plumbing Committee of the Building Research Board of the Department of Scientific and Industrial Research.

5. THE PAINTING OF BUILDINGS

By a Committee convened by The Paint Research Association.

6. GAS INSTALLATIONS

By a Committee convened by The Institution of Gas Engineers.

7. STEEL STRUCTURES

By a Committee convened by The Institution of Civil Engineers.

8. REINFORCED CONCRETE STRUCTURES

By a Committee convened by The Institution of Structural Engineers.

9. MECHANICAL INSTALLATIONS

By a Committee convened by The Institution of Mechanical Engineers.

10. SOLID FUEL INSTALLATIONS

By a Committee convened by the British Coal Utilisation Research Association.

11. ELECTRICAL INSTALLATIONS

By a Committee convened by The Institution of Electrical Engineers.

12. THE LIGHTING OF BUILDINGS

By the Lighting Committee of the Building Research Board of the Department of Scientific and Industrial Research.

13. NON-FERROUS METALS

By a Committee convened by the British Non-Ferrous Metals Research Association.

14. SOUND INSULATION AND ACOUSTICS

By the Acoustics Committee of the Building Research Board of the Department of Scientific and Industrial Research.

15. WALLS, FLOORS AND ROOFS

By a Committee convened by the Royal Institute of British Architects.

16. BUSINESS BUILDINGS

By a Committee convened by the Royal Institute of British Architects.

19. HEATING AND VENTILATION OF DWELLINGS

By the Heating and Ventilation Committee of the Building Research Board of the Department of Scientific and Industrial Research.

The following are in course of preparation:

17. FARM BUILDINGS

By a Committee appointed by the Minister of Agriculture and Fisheries.

18. THE ARCHITECTURAL USE OF BUILDING MATERIALS

By a Committee convened by the Royal Institute of British Architects.

20. FIRE GRADING OF BUILDINGS

By the Fire Grading Committee of the Building Research Board of the Department of Scientific and Industrial Research, and of the Fire Offices' Committee.

21. SCHOOL BUILDINGS FOR SCOTLAND

By a Committee appointed by the Secretary of State for Scotland.

22. FARM BUILDINGS FOR SCOTLAND

By a Committee appointed by the Secretary of State for Scotland.

HIS MAJESTY'S STATIONERY OFFICE