sight, yet we find cross lighting in comparatively recent schools in the British Isles. Had similar investigations been applied in the case of the dwelling there is little doubt that the benefit derived from direct sunshine would have been revealed.

Unless sunshine is admitted to the dwellings allotted to animals kept for profit, no profit will accrue. If the house owner's profit was dependent on the health of the occupiers of his dwellings as the cattle owner's is on the health of his beasts we should have far more sanitary dwellings.

Some Engineering Amenities of Housing.

By A. P. I. COTTERELL, M.Inst.C.E. (Fellow).

(ABSTRACT.)

WHETHER the new housing be in town or country there are engineering services that must be introduced if it is to satisfy modern requirements.

The first of these is an adequate water supply. Water supply will, of course, be provided for the new housing. The only question is whether it is to be taken from private sources, such as wells or from public water mains. In almost every case it is to be hoped it will come from water mains, but there are cases of isolated country villages that have no public supply, and cannot therefore provide it for the new houses. The Women's Housing Sub-Committee has laid it down that an improvement in the water supply of country districts is a matter of national urgency. The author suggests that private wells should be regarded as inadequate except in the rarest of instances, and that it should be a condition of the new housing that a piped public water supply from an unimpeachable source should be provided. Existing public or privately owned sources of water supply should also be looked into, where necessary improved to accommodate the new centres of population, and one water supply co-ordinated with another without regard to its particular district so as to save some of the overlapping and waste that now occurs.

It may be noted also that the universal introduction of baths and other services will considerably increase the water consumption per head, and will necessitate an enlargement of existing works as well as the construction of new ones.

Next in importance is efficient sewerage. Probably there is little to be said as regards the larger centres, where public sewerage will be provided without question. But in many rural areas sewers will not be available unless specially provided under the housing scheme. In the Report of the

Women's Housing Sub-Committee the suggestion is made that where there is no public sewerage there shall be not more than four houses to the acre, in order that there may be sufficient land for sewage disposal on the garden. On some soils this can be done, and the sewage can be used with advantage. But it will not be so in all cases, and there will be times when the sewage will be a drug and a nuisance. On the score of economy there is very little difference in cost between separate cesspools or other private means of disposal and a properly designed system for a score or more of houses. Collection to one site involves responsibility and oversight by the Local Authority, but this is partly what Local Authorities are for. If the antiquated and useless bye-law prohibiting the overflow of a cesspool into a sewer were modified there is no reason why country householders should not have properly designed catch pits on their outfall drains, whence they can pump liquid for watering their gardens, and the remainder should be dealt with by the Local Authority.

In some isolated country places earth closets can no doubt be used with advantage, but they should be attended to by the public service rather than be left to the householder. Bath waste water might also be disposed of separately with advantage. But it will be found that almost everywhere the householder will ask for complete sewerage, and it will be true economy to provide it.

The construction of properly graded roads is distinctly an engineering problem, especially if it involves such works as bridges, culverts or tramways. There is not room or need, however, to deal with such matters within the limits of this paper since our theme is chiefly directed to the immediate needs of the house itself.

It is therefore proposed to briefly discuss the following engineering amenities: Lighting and power for labour saving, heating and hot water supply. These branch out into various forms, and are to some extent interchangeable, but all that is here intended is to treat them generally.

It will be agreed that wherever there are groups of new houses some kind of communal lighting should be provided. Many will also agree with the Women's Housing Sub-Committee that "from the housewife's point of view electric lighting is bound to be preferred to gas if the cost is no greater," and that "all new building should be carried out with these possibilities (of electricity) in view."

In the large towns gas and electricity will both be available, and the author's plea is that in the country districts also, wherever there is any considerable grouping of houses similar facilities should be provided. It is first cost that will be the bugbear, but this is the opportunity for getting over that difficulty. Local Authorities and Public Utility Societies should be empowered to purchase in bulk gas and electricity for the purpose of distribution

to householders, and even to instal their own system where there is no prospect of obtaining it from an existing source at a reasonable price.

If in the future electric current be carried nationally over the country, much as the telephone is to-day, there are various household uses to which it may be put. These concern the larger houses rather than the smaller, but such household services as dust extraction by suction, grinding, polishing and other mechanical operations might be done electrically and so save much labour. They will have to await the introduction of simple appliances, and it is to be hoped that inventors will turn their attention in this direction, as such development might largely help to solve the domestic labour problem.

The provision of heating facilities is closely mixed up with that of lighting, and they must be considered together. A supply of gas will, to a large extent, serve both for lighting and heating, and the day may not be far off when electric current will be as efficient as gas for heating and cooking, taking all considerations into account. For efficiency does not lie in price alone.

The respective cost of a supply of the same amount of thermal units for heating purposes by way of coal gas or electricity has been estimated to be :—

Coal ...	...	...	...	...	...	1·
Gas ...	...	...	...	...	...	2·2
Electricity ...	...	...	...	...	...	8·

But gas and electricity are so much more efficient than a coal fire as to be able to hold their own when all considerations are taken into account, and in small houses where care is taken not to waste gas or electric current they may be even cheaper than a coal fire that has to be maintained in order to deal with cooking requirements as they arise. Hence the daily heat unit consumption in the coal range is considerably larger than that in the gas cooker. The electric cooker competes with the gas cooker in that it makes even better use of the heat units consumed.

At the Swanpool Village, Norwich, it is proposed to erect a special electric installation for the supply of current for lighting and cooking. Another feature is the proposal to utilise spare steam from adjoining works for hot water and heating. It is understood that these services will be done for 6s. per week, and it is claimed that there will be a saving in the cost of construction.

At another projected village, in the north, it is proposed to instal electric cookers, and to put electric fires in all the rooms of the house save one, which will be provided with the ordinary coal fire.

The author's personal experience with a gas cooker at 2s. per 1,000 cubic feet and subsequently an electric stove at 1d. per unit has been that with care the cost per week runs out to about the same.

Economies in construction and maintenance can and should be effected by the provision of gas or electric supplies.

The kitchen range, for instance, so uneconomical in its use of coal and so productive of dust, ought to be superseded, an ordinary gas or coal fire, or at most an interoven being provided in its place, except in colliers' villages, where coal can be obtained at a specially low rate. These are days when coal consumption is a national concern, and the reign of the coal range of whatever type, whether open or closed, ought to be brought to an end.

But this can only be done in the cottage by providing efficient substitutes. The fire is needed for more than cooking; it is wanted for hot water and for drying when washing is done at home. At all events if hot water supply can be provided in another way, facilities for heating and cooking can readily be given by gas and possibly by electricity with the addition of a coal fire in the living room or possibly a "back-to-back" stove in the scullery to also serve the living room as an open fire as suggested in the Women's Report.

From the point of view of the country village or town, even though the cost is greater than coal, there will be many cases, especially when former town dwellers move into the country, where they will welcome these facilities even at a slightly increased charge.

We now come to the supply of hot water. This is one of the most urgent requirements of the housewife. Mrs. C. S. Peel, a well-known authority, has said, "I have been collecting letters from working women, and they all demand, before everything else, hot running water in every home." The First Interim Report of the Women's Reconstruction Committee urged that "A regular and efficient hot water supply is a *sine qua non* from the point of view both of personal cleanliness and of labour saving."

A hot water supply worked with a coal cooking range, as is commonly done, has the double disadvantage that it is not only extremely wasteful of heat, but it necessitates a larger fire, even in summer, when otherwise cooking might be done on a gas or electric stove and the fire dispensed with altogether. To overcome this a supplementary boiler has been introduced into many larger houses, fired by coke, anthracite or gas for hot water only, sometimes worked alone and sometimes connected with the pipes from the range boiler for use when the range is out of action.

The Liverpool Corporation has supplied continuous hot water from a central station to 66 tenements, each containing a bath, since 1913, at a cost of 6d. per tenement per week. A Manchester Corporation Committee Report in 1918 states that it has received estimates for hot water supply to an estate of 200 houses (10 to the acre) at 1s. 2d. per week per house, and for 400 houses at 8½d. per week, whilst the capital cost per house works out at £22 17s. (or £20 17s. with 400 houses), against at least £24 per house on the separate

system. The Tudor Walters Committee estimate the cost at 9d. to 1s. 9d. per house per week. Most cottagers would not consider 1s. per week too high a charge for a constant hot water supply.

On a larger scale there might be a central system of steam piping for a considerable number of houses, such piping being carried to sub-station calorifiers arranged for groups of ten to twelve houses, whence hot water would be piped to the respective house fittings. As is sometimes done with electricity, the supplies might be charged at a flat rate per house, with the right to fix a meter and to make an extra charge if the consumption exceed an agreed maximum.

In any such communal system of hot water or steam supply, allowance must be made for heat losses, and must, as far as possible, be provided against.

It is estimated in the north that most householders burning only one fire a day consume about 2 cwts. of coal a week on the average, ranging from 3 cwts. in winter to 1 cwt. in summer. In the south it may be a little less.

If the summer consumption represents the amount needed for hot water, limited and intermittent as it is at the best, the cost at 2s. per cwt. is 2s. per week.

It may be taken that an ample hot water supply per day would be :—

For the bath...	...	...	...	...	30 gallons at	100° F.
For washing	...	...	...	...	15 "	150° F.

Heating water by *gas* to 100° requires on the average $1\frac{1}{4}$ cubic feet of gas per gallon, and to 150° $2\frac{3}{4}$ cubic feet. The cost of heating the above water supply at 4s. 6d. per 1,000 cubic feet would therefore be 2s. 6d. per week. Radiation losses must be taken into account as well as the set off of reduced consumption possible by the use of the thermostat.

In heating water by *electricity* $\frac{1}{2}$ unit is needed to boil one gallon. Therefore, for the same quantity and heat as above given, the cost at $1\frac{1}{2}$ d. per unit would be 8s. $2\frac{1}{2}$ d. per week.

On a *communal system* the same equivalent quantity of water heated in a boiler and supplied at a steady temperature of 150° would absorb 20 lbs. of coal per house per week. Heat radiation losses, reduced by protection to the lowest point, and the cost of supervision must again be added, but after allowing liberally for the former it would appear quite possible to supply hot water to groups of houses from 60 upwards within the prices already estimated at Manchester and in the Tudor Walters Report.

The extra capital outlay involved in either of the above systems of heating should be set against the corresponding reduction of cost in the house and its fittings.