gether disagreeable. Fig. 5 shows exactly the stiff attitude the head is compelled to take in order to rest.

Finally, Fig. 6 reproduces the comfortable position indicated in Fig. 3, and at the same time represents the profile of the back of the seat actually in use in our railway carriages. On comparing this profile with the position of the man comfortably supported, the following defects in the back of the seat are observed:—

1. It is too vertical.

2. It allows an empty space between the lumbar vertebræ and the lower extremity of the shoulder-blade exactly at the place where one is in the habit of putting a cushion "behind the back," as it is called.

3. It is at least half a foot too high, and so makes it impossible for the head to rest behind. It is customary to make the back of the seat tally with the height of a man of average size seated bolt upright.

Under the actual conditions, such as they have been

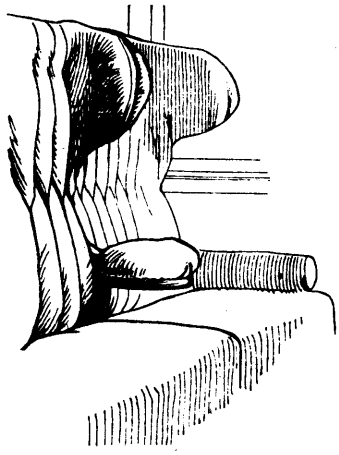

FIG. 6.

described, what becomes of the traveller when sleep at length overtakes him? Little by little he slides down on his seat till the lower extremity of his shoulder-blades, which has most need of support, finds the most sensible projection, which, as the backs of our railway carriages actually are, is precisely where it is least serviceable—at a point, namely, on a level with the region of the pelvis. Lastly, the head inclines forward or to the side, if it does not bury itself in the breast (Fig. 7).

Fig. 8 gives a front view of the face of the bench serving as the back of the seat. In the centre is seen a stuffed projection, on each side of which a passenger may rest his cheek. The shoulder, getting no separate support, must contrive to lodge itself between this stuffed projection and a kind of plateau fixed in the side of the back of the seat, and which, situated about a hand's breadth above the seat, offers a resting-place to the elbow (Figs. 8 and 9).

IMPERMEABLE CONSTRUCTION IN REFERENCE TO VENTILATION AND WARMING.*

BY E. C. ROBINS, F.S.A.

The enclosing walls of every house are an important factor in considering its sanitary condition; so also is the roof covering, which, together with the walls, constitutes its power of resistance to the winds and weather of our inclement climate. Until late years, however, the site covered by the walls and roof of any building has been thought to be sufficiently protected by them, and the existence of such a thing as "ground air" has been ignored in constructing the lowest ground or basement floors of buildings.

Having myself witnessed Dr. Renk's experiments at the Hygienic Institute at Munich, which he has been for years carrying on under the supervision of Dr. Pettenkofer, I am able to speak from ocular demonstration concerning the penetrability by air and water of the materials commonly used in the construction of buildings both public and private.

There are circumstances under which it may be desirable that the air should find its way through walls; for example, wherever no other means are provided for the change of the air in dwellings. Indeed, were it not for the flimsy construction of the houses of the poor, and the passage of the air through the outer walls, and through the crevices about door and window openings and basement floors, the air of the rooms would become perfectly stagnant, and be much more unhealthy than it is. But in the construction of the houses of the future upon sound sanitary principles, it is of course presupposed that nothing comes by chance, that the providence of the designer anticipates and provides for every contingency, and thus puts under the control of the occupier the means of warming, ventilating, and maintainining in healthful condition the house he inhabits. To attain this end, it is obvious that in the first place it must be possible to insure that the basement floor shall be impervious to ground air and moisture.

But what is ground air? It is the superincumbent pressure of the external atmosphere which passes through the earth subjected to its pressure to find its escape in the direction of the least resistance, which direction is commonly that forming the site of a house. The resistance to this external pressure is much reduced by the temperature of the air within the house, which is usually much higher, and consequently much lighter; so that there is every inducement from natural causes for a stream of ground air to be continually passing through the basement, or lowest floor from without, unless steps are taken to construct an impervious flooring, the resistance to the passage of the air through which shall be greater than the pressure.

When the earth is clean and the house is pure there may be no great harm in allowing this process to go on, but for one consideration, viz., the humidity of the air so passing during wet seasons. But in populous places, where the earth is fouled by innumerable accumulations of refuse of all kinds, and where defective drainage has rendered pestiferous the very soil upon which the house stands, and leaky gas-pipes have rendered the external soil black and reeking with gaseous deposits, &c., I say under these circumstances it becomes a matter of enormous moment that the house itself shall not be made the safety-valve for the reception and accumulation of all these abominable impurities in the form of imperceptible "ground air."

IMPERMEABLE BASEMENT FLOORS.

There are two ways of overcoming this evil. The one is by forming an impervious flooring as before mentioned, and the othes is by constructing channels under the floor leading to the kitchen chimney flue. These channels should be of porous materials, and should be 6 ft. apart; and by being carried to the kitchen chimney, the ground air will be drawn off with the heated air and smoke of the chimney, and tend to increase the draught in the flue at one and the same time. This was accidentally discovered by Dr. Renk during his experiments at Munich; for, being unable to account for the difference of ground air pressure in different parts of the basement upon which he was operating, he excavated the floor, and found that one of the air flues from the chemical laboratory passed under the basement floor to the foul air extract shaft, drawing with it the ground air in its immediate vicinity, thus relieving the pressure upon a certain area, and giving the confirmatory exception to the rule he was formulating.

The ordinary materials for paving basement floors are all of a very porous character, and where boarded floors are provided no attempt used to be made to cover the soil at all, till the last amendment of the Act governing these matters required a thin layer of lime concrete to be laid over the earth under the floors generally.

The experiments made on various materials show that hydraulic cement is always impermeable, and a layer of cement concrete covered with pure cement, or an asphalt surface, or concrete formed of Portland cement mixed with granite or slag chippings, and finished with a smooth surface, will answer the purpose desired. But, for the sake of comfort and warmth to the feet, it is often desirable that wood should be the covering. This is equally well secured by the adoption of one or other of the many excellent wood block floorings exhibited in this great International Health Exhibition, to be laid on 6 in. of cement

*A paper read at the Conference of Architects at the International Health Exhibition.