hot-water tank. The warming of the Madeleine Church, containing 2,000,000 cubic feet of space, had also been undertaken by M. Duvoir at a cost of 11*s.* 2*d.* per day; and also the ventilation and warming of the Palais de Justice, a prison, and several other public buildings, as well as a number of private houses: the warming of eight story houses had been undertaken by him at from 3*s.* to 4*s.* per day, and the very small quantity of coal consumed for the purpose was remarkable. On a small scale the same principle of ventilation by suction might also be carried out by simply placing a lighted lamp or candle in the bottom of a properly constructed air flue; or by building air flues parallel and contiguous to the chimney flues, so as to be heated by the latter. The simple manner in which the ventilation by suction had been carried out in the Lecture Theatre of the Conservatoire under General Morin's directions, the ventilation being completely maintained without requiring special attendance, appeared to him to be much in advance of any attempts that he had met with previously; and he thought it would be a great benefit if the same plan could be introduced in England for the ventilation of public buildings.

In conjunction with the ventilation of buildings, the warming of the air supplied had hitherto been the chief subject of attention in France and England and other northern countries; but for hot weather even in this climate it was desirable that attention should be given to the corresponding question of cooling the air, and in the tropics this was an absolute necessity. In an experiment made by M. Duvoir at the Palais de l'Institut on cooling the supply of fresh air by passing it between a series of pipes through which a stream of cold water flowed, the meeting hall had been cooled down to a considerable extent on a hot summer day, while occupied; and this result deserved the particular attention of any one entrusted with the ventilation of buildings in India or other tropical countries, where the effectual cooling of the air was of such great importance.

Mr. J. Whitley concurred in the importance of having a system of ventilation not requiring constant attention, particularly for private houses where such attention was out of the question. Having himself carried out for house ventilation in a large number of cases the principle of suction advocated in the paper, he had found that, by simply taking advantage of the rarefaction produced by the ordinary chimneys, sufficient exhausting power was available for ensuring a constant supply of fresh air in all the rooms and passages of a house; and by this means a room closed and fully occupied for a length of time, such as a sleeping apartment, was made to retain as pure an atmosphere as if unoccupied. In the plan that he had used, a suitable outlet from the room into the chimney was made at the level of the ceiling for the escape of the vitiated air, and a corresponding inlet for the fresh air was made in a distant part of the room; and whenever the chimney was not heated by a fire in the room, a jet of gas lighted at the bottom of the inlet to the chimney was found sufficient to produce the necessary amount of rarefaction, as named in the paper.

Mr. Bramwell enquired whether it had been found necessary, in the system of ventilation described in the paper, to introduce any moisture along with the supply of air artificially heated.

General Morin replied that he had not found any necessity for introducing moisture with the air supplied, because he had adopted the plan of heating only a small portion of the air, and mixing this with a quantity of fresh cold air, so that the mixture contained a sufficient supply of moisture to prevent any sensation of dryness, without requiring any addition of moisture by artificial means. When the whole of the air supplied was heated, as in the case of the British Museum, and St. George's Hall, Liverpool, it was generally found necessary to provide special arrangements for restoring to the air the degree of sensible moisture which it had previous to the heating process. But in most cases only a moderate amount of heating was required even in winter, as it was found that the air supplied should be introduced at a temperature of $3\frac{1}{2}^{\circ}$ to $5\frac{1}{2}^{\circ}$ Fahr. below that to be maintained in the building. In the case of the Lecture Theatre in which they were now assembled the extent of accommodation was limited to about 700 persons, but the ventilating arrangements had been carried out upon a scale which would be amply sufficient for an assemblage of 1200 persons.

Mr. C. W. Siemens thought there must be more need of moistening the air in winter than in summer, because at a lower temperature the point of saturation of the atmosphere was lower, and when below the freezing point it was devoid of moisture altogether; while at the same time there would then be the greatest proportion of heated and dry air to be mixed with it. He enquired whether in winter there was ever found to be any necessity for adding moisture to the air.

General Morin replied that in a room containing only two or three persons it might under such circumstances be desirable to moisten the supply of air, because the quantity of moisture exhaled in respiration was not then enough to saturate the air. But in an assembly of a great number of persons there was an objectionable excess of moisture in the atmosphere from exhalation, and therefore in most cases, instead of adding moisture to the air, the object to be aimed at he thought was rather to introduce dry air, with a view to get rid as far as possible of the excess of moisture already existing in the atmosphere of the room.

Mr. C. W. Siemens enquired in reference to the plan that had been mentioned, of cooling the supply of air for ventilation in hot countries, whether General Morin had made any experiments on that subject, and whether the mode of carrying out the system of suction would be the same in that case, by introducing the cold fresh air at the ceiling and drawing off the vitiated air below, or whether the arrangement would have then to be reversed. It would be very advantageous he considered if the plan of introducing the fresh air at the ceiling could still be adhered to.

General Morin replied that an illustration of the supply of air for cooling purposes was afforded by the Lecture Theatre in which they were now assembled, where the internal temperature was at all times of the year above the required degree when the room was fully occupied, and needed always to be kept down by a liberal supply of fresh cool air, which was introduced at the ceiling, the ventilating arrangements in this case having been completely carried out according to the system described in the paper. At the Corps Législatif, on the contrary, the cold air was introduced at the floor of the assembly hall, through very narrow openings of only about 1 inch height, situated in the risers of the steps; and the result had been the presence of very disagreeable draughts about the legs of people, showing the mistake of letting the fresh air enter at the floor. At the present moment the supply of fresh air in the Lecture Theatre was at the rate of as much as 13,000 cubic feet per hour per person; but as it was introduced at the ceiling of the room and through a number of large openings, there was not the slightest sensation of draught, while the atmosphere in the room was maintained fresh and cool. Even had the day been considerably hotter, the extent of ventilation provided for would have been sufficient to keep down the interior temperature below that outside. In special experiments he had employed the pipes of the heating apparatus for the converse purpose of cooling the air, by circulating a stream of cold water through them, and making the supply of air pass between them on its way to the entrances of the room. By this additional means, when the temperature in the room had been 68° Fahr. and the external temperature 66° Fahr., he had succeeded in reducing the internal temperature by 4° or 5° Fahr. In the case of intense summer heat or in tropical countries the requisite cooling effect might no doubt be readily obtained by having recourse to a fine spray of water in the main air passages in the basement of the building, just sufficient to moisten the whole of the surfaces over which the fresh air had to pass in entering, so as to bring into play the cooling effect of rapid evaporation. He had originally contemplated applying this mode of cooling in the ventilation of the Conservatoire, but he had found in practice that an ample cooling effect was obtained by the abundant ventilation, without the necessity of this additional provision for the purpose.

Mr. W. Fairbairn considered the subject of ventilating large public buildings was one of the greatest importance at the present day, and required serious consideration. In the paper just read he had been much struck with the large allowance of air stated to be required for the efficient ventilation of buildings where a number of people were congregated together, amounting to as much as 1500 to 2000 cubic feet per hour for each person. In the case however of a barracks in London, it had been found that the quantity of fresh air supplied was less than 500 cubic feet per hour per individual; and the result had been that men who came strong and healthy from the country became consumptive in a few months and a great number died, the rate of mortality being even greater in the barracks than on a campaign. He enquired whether the principles of ventilation enunciated in the paper had been applied to any of the barracks in Paris.

With regard to the mode of effecting the ventilation by introducing the fresh air at the ceiling and taking off the vitiated air at the bottom, this was a direct reversal of the plan generally adopted in England, of supplying the fresh air at the bottom and discharging the vitiated air at the top of the room, which he himself had hitherto been accustomed to consider the most natural way of ventilating a building. There was no doubt however that the system described in the paper possessed an important advantage in the very slow velocity at which the fresh air was brought in, amounting to only 2 or 3 feet per second; and it was evident that with such a velocity there was not much danger of any person catching cold in the room, as the speed was not sufficient to produce any sensation of draught. Moreover by removing the vitiated air at the bottom, the carbonic acid gas, which constituted the principal element of vitiation and naturally tended to the bottom by its greater specific gravity, was taken off at once, without contaminating the fresh air in the rest of the room; and this he thought was a very important feature in the system. A somewhat greater force of draught would of course be required to take off the vitiated air at the bottom instead of the top; but it was no doubt worth while to have rather more heating power for this purpose in the upcast shafts, on account of the advantage attending the immediate removal of the vitiated air at the bottom of the room. He hoped there might be opportunities of seeing the same mode of ventilation tried for public buildings in England, where there was at present so much room for improvement in that respect.

General Morin said he had seen the report of the English commission upon the ventilation and warming of barracks, and had been much interested in the excellent plan of ventilating chimney proposed for the purpose by Capt. Douglas Galton. Experiments had also been