

hope they will not neglect to provide for all the elements which tend to comfort and healthy living, and that they will in the future as in the past continue to apply the most perfect systems in heating and ventilation.

#### DISCUSSION.

The President: Gentlemen, as I said before, we wish a full discussion on this paper of Prof. Carpenter's. We have with us this afternoon men who are quite capable of discussing and asking questions that may be pertinent to its subject; it is perhaps the most important subject we, as architects, have to deal with, for after all it matters not how beautifully we design a man's dining room or how artistically it is decorated and furnished, if he comes down in the morning and cannot get the room up above 60 degrees. Therefore I think Prof. Carpenter's paper is upon a subject we cannot pass lightly. As we have him with us it is possible he will forgive us for asking him a few questions on the subject.

Mr. S. G. Curry: Mr. President and Gentlemen, I have much pleasure in moving a vote of thanks to Prof. Carpenter for the very instructive paper he was kind enough to read to us. I do not know whether there is much room for discussion, because I agree with nearly everything he said. I think where there is a disagreement there is usually more discussion than where there is an agreement. There is only one point raised that I should be inclined to question, and that may be theoretically correct. It is with regard to the variation of hot water and steam surface. I find it is necessary to have 2 to  $2\frac{1}{2}$  times as much surface for steam in our climate; it may be due to the fact that I am in the habit of not using more than a pound pressure. In lieu of the gravity system a system arranged for working practically with little or no pressure, we have a system with little or no force in it running up four or five pounds of steam. Under these conditions possibly the proportions Prof. Carpenter states are practically correct, more theoretically correct than in fact, because like all these things it is a question how you consider the matter. I have been in the habit of figuring steam by the pound or less; and as far as I know I find my arrangement has answered every purpose satisfactorily. The address has been most satisfactory; in fact it has taken up all the different points in a thoroughly practical and sensible manner. It has gone over the history of heating pretty thoroughly and it is put in a very plain and comprehensive light. I do not know as I am in a position to do any criticising. As I said before, I agree with nearly everything that has been said, and I wish to compliment the Professor on his paper being most thorough in every point, and satisfactory; and I am quite satisfied it will be of great benefit to the members of the Association.

Mr. Burke: I have very much pleasure in seconding Mr. Curry's motion. I must express my surprise at the improvement in heating that is displayed in the "vacuum" system; the small water power is certainly astonishing compared with the amount of power required where they are depending on pressure to force the heat through the pipes. I have a system today in use where it is almost ridiculous to see the amount of water power that is used for the large quantity of surface to be heated; and yet the building is being heated. In regard to the exhausts I did not understand whether those were exhausts which were taken back to the furnace or taken back to the outside. I had a little experience in my own house with regard to the exhausts; I could not imagine why one of the flues would not heat and I went to the one built connected with the chimney and I found a great amount of cold air coming into the flue and passing from that down to the furnace, making it impossible to heat the room.

The President: I see we have several well known representatives of the trade here, and some of them may have had practical experience in those systems. Can we not hear from one of them?

Mr. Purdy: Mr. Gurney, Mr. Mansell or Mr. Armstrong.

Mr. Armstrong: I have had no practical experience in the use of any vacuum system, but I am interested in the description of the Morgan system, and I

would like to ask what is the height of the column of mercury that they employ. I also notice he takes the air pipes and returns them to the boilers. I am very much interested in that, and if Professor Carpenter will give us that information I am sure every member would be delighted to hear him. Another point, the proportion of 1 to  $\frac{2}{3}$ , I would like to ask if that is hot water at 212 degrees and steam at 212?

Professor Carpenter: In regard to the question asked by Mr. Armstrong, first, in respect to the apporportioning of the radiating surface of hot water and steam, it is rather interesting in the way it came out. I figured it out on a theoretical basis that the proportion ought to be about 100 to 164; and the American Society of Boiler Makers, from an entirely different system of figuring, concluded that 166 would be the equivalent of 100 of steam. I got at it in an entirely different way from that but the results were the same I think from a theoretical and practical standpoint. We are now putting in radiators in that proportion, that is, giving the one and two-thirds square foot of hot water radiators where we put in one of steam. The whole thing depends on the temperature you run your hot water radiator at. This calculation is based on hot water about 180, as you will find if you calculate it through. If you run them at a lower temperature the radiators would have to be larger. That has got to be an almost standard practice; it was adopted almost unanimously after a long discussion by the American Boiler Makers; I was present and took part in the discussion at the meeting at which they adopted it. Regarding exhaust flues in the hot air furnace. I had in mind what I have often done in the hot air systems, that is, carrying exhaust flues up into the attic, not putting them outside because that leaves them in a position by which we can draw the cold air down into the room. But I have found in nearly every case that if these flues are simply carried to the attic they are certain to keep the system in equilibrium without bringing in cold air; but the hot air system is subject to vagaries; one sometimes finds the hot air going out through the cold air box, and the cold air coming out through the warm air flues.

Mr. Armstrong: I would like to know if the temperature the steam gets to at 120 is equal to the steam raised to 212 degrees in the vacuum? I understood that, you raise some hot water at a temperature of 120 degrees in the vacuum system. I would like to know if the steam is the same temperature as that raised from hot water at 212 degrees.

Prof. Carpenter: That depends. Steam is at an absolute pressure of two pounds per square inch. The atmosphere gives us fifteen pounds per square inch; if you pump up thirteen pounds that water will boil at 126 degrees; the steam would be about that temperature 120 degrees; with the whole atmospheric pressure of 14  $\frac{2}{16}$  pounds steam is formed at 212 degrees. Steam at two pounds pressure would be formed at a temperature of 216 degrees. So that you see if we can reduce the pressure we can get almost any temperature we desire with the steam. And that was the intention with these systems.

Mr. Gurney: Do you consider the system of hot water heating, where the water is super-heated under pressure, getting the water so much hotter, an economical way of heating it?

Prof. Carpenter: The pressure system of hot water heating was given up because it was believed to be dangerous. I have never felt that it was safe; there are so many things which might happen, especially when you consider how the water is managed in the ordinary domestic heating. It seems to me it is almost suicidal on the part of people to use it; and for that reason I have never felt safe to recommend it. I would recommend it if we could raise the boiling point of water without increasing the pressure, by putting in glycerine or something of that kind: but the objection to that is the expense.

Mr. Gurney: In using glycerine is the circulation as perfect as without it?

Prof. Carpenter: Yes, it is perfect. We have been