Progress in Heating and Ventilating During the Past Quarter of a Century

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MEMBER

TWENTY-FIVE YEARS have passed since the tenth anniversary of the formation of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. On that occasion our valued member, Prof. Rolla C. Carpenter, presented an interesting, though brief, review of the art of heating and ventilation as it had existed and developed during the period of fifty years prior to that commemoration.

Now that art has made its way along the path of modern progress during another quarter of a century, and it may be well to regard the present year as another milestone, from which we may look back and take note how far we have traveled, and over what obstacles we have made our way.

Such retrospective consideration has a practical value if it induces us to reflect upon our own limitations, and also to compare our present advantages of accumulated knowledge and available materials with the limitations and difficulties through which our predecessors struggled to achieve success.

We may reflect without undue pride that in the processes of heating and ventilation, we are dealing with a matter which more directly than any other branch of the mechanical sciences conduces to the necessities of mankind. Man could eke out his life without many modern devices and conveniences, but he is and will always remain dependent for his very existence upon respiration, temperature, and humidity.

Contribution to Disease Reduction

With the reliable and adequate provision of warmth and pure air, our branch of science has made no small contribution to the reduction of disease, and to the prolongation of human life, during the past quarter of a century. We may congratulate ourselves that we, the heating and ventilating engineering profession, have contributed to this desirable end. But we must modestly admit that we have been aided in our progress by the improvement of appliances and materials, and the increase in scientific information which has accompanied the rapid march of modern developments.

We have, moreover, to credit our predecessors with the initiation of methods and the achievement of results, by which we have benefitted, methods adopted and achievements accomplished by them with a restricted supply of dependable information, and without the experience and the means and materials which we now find so readily available.

At the tenth annual meeting of the Society in 1904, Hugh J. Barron had presented a review of existing literature bearing upon the subject of heating, which was chiefly in the form of papers that had been communicated during the prior decade to the *National Association of Master Steam and Hot Water Fitters*, and to the *Heating and Ventilating Institution of Great Britain*. These were supplemented and enlarged by the topical discussion and some valuable papers contributed by the membership of our own Society. These presentations had, by 1905, gradually built up an accumulation of records of the experiences of individual theorists, scientists and engineers.

Reference Books in Use

But apart from these rather discursive items of information there was a lack of standardized literature and of factual record. The most dependable book of reference was that admirable work by the lamented Carpenter, Heating and Ventilating Buildings,[2] supplementing William J. Baldwin's highly successful book, Steam Heating for Buildings[3], which was published in 1881 and had run at that time through fourteen editions. And a much-needed contribution upon the subject of ventilation in school buildings appeared in 1905, written by Joseph A. Moore, Inspector of the Public School System in the State of Massachusetts.[4]

Our problems of the first years of this century were largely attributable to the absence of many of those improved appliances, and materials which have since been rendered available. We were still wrestling with the question of pipe sizes, to which James A. Donnelly had begun his contributions of experiment and original study. Some work had been done in determining the transmission of heat through various building materials.

The effect of wind upon building surfaces, and the extent of inward leakage into buildings were occupying attention. Our problems were intensified by the development of tall buildings in great cities, constantly increasing in height. Compulsory ventilation in school buildings had made an advance by the action of the Legislature of the State of New York, in passing the bill requiring adequate ventilation of schools, the culmination of many years of effort.

Typical Problem of 25 Years Ago

I may venture to illustrate the circumstances of the work of planning the heating of buildings twenty-five years ago by my own experience at that time. In the year 1905, I found myself confronted with problems of a somewhat unusual character in the preparation of the

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[2] Heating and Ventilating Buildings, a manual for heating engineers and architects, New York, 1895.
[3] Steam Heating for Buildings, or Hints to Steam Fitters, N. Y., 1881.
[4] The School—Its Heating and Ventilation, Boston, 1905.

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preliminary plans and computations of the heating system to be applied to the Grand Central Terminal in New York City. This was a group of prospective buildings of unusual character, spread over a large area and of possible increases in size which at that time were mere matters of conjecture. The system to be devised, therefore, required consideration of future extensive developments and the provision of steam supply capable of very considerable future expansion. There being no available body of recorded proportions it was necessary to compute the probable heating requirements of every element in the project as an individual problem.

It is of interest to record that the final decision in regard to the nature of the heating system was in favor of the use of a forced circulation of hot water rather than the distribution of steam. An unusual feature in the entire group of buildings was the provision of working space upon an upper floor of each structure, as there was no basement in these buildings, the space being occupied by the railroad tracks. The lower floors of these buildings are hung from girders extending through this working space, through which the main piping of the heating system had to be arranged and return piping had to be planned through the lower story and some part of the public terminal spaces. Radiating and piping proportions had to be decided largely by the exercise of judgment rather than by recorded experience. I am glad to be able to record that this extremely interesting problem was successfully solved.

Then came a question which had up to that time attracted little consideration, namely the current expense of operation of this extensive installation. The design of a steam-producing plant was then developed and it is interesting to note that this plant, situated on Fifty-first street, continued in service for a period of twenty-five years, having been quite recently dismantled to make way for the Waldorf-Astoria Hotel, the steam for the plant being now supplied by the underground system of the New York Steam Company. This problem involved a study of recorded weather conditions over a long period, and consideration of average temperatures, and average use of heat.

One of the developments in the planning of heating plants, derived from actual tests of heating systems grew out of these studies. The prolonged and detailed test of the heating and power plant in the Hall of Records in New York City afforded much information on the variations and the total quantity of steam which was required in modern buildings, accompanying the variations of exterior temperature and wind movement. Later tests have established a firm relation between the cubical contents of a building and the usage of steam in heating it.

Comparisons of the actual amount of steam used from hour to hour in cold weather has thrown a great deal of light upon the economic side of the subject. It has been followed in recent years by studies of the comparative use of steam and of hot water as a medium for the transfer of heat, and also of the relative advantages of maintaining a fixed interior temperature during the night time in unoccupied buildings, or of the discontinuance of the heating process during that period. As a result of these investigations and determinations the cost of the heating of buildings has gradually become defined and should now no longer be a matter of mere estimate.

Development of Appliances

During the period covered by this review it has been noticeable that the manufacture of appliances used in the work of heating have developed many improvements in heating apparatus and in greater variety, which has greatly aided in the design and operation of modern heating plants. Electrically operated blowers and fans have become available in all sizes and types. A notable improvement, which was introduced in 1906, was the *squirrel cage* type of blower, which has since that time demonstrated its efficiency and has become a substantial aid in the work of ventilation.

Attention has been directed and most important developments have followed upon the question of the purity of the air dealt with by systems of ventilation. The purification of air introduced into buildings may be rightly considered the greatest advance which has been made in ventilation during the past quarter of century.

What we now rather clumsily describe as the process of *air conditioning* is largely due to the lifework of our esteemed Vice-president, W. H. Carrier. It has had the effect of lifting the subject of ventilation from a mere mechanical system to a scientific and hygienic process. Its importance has been upon an increasing scale, since the contamination of air in great centers of population has proceeded on an increasing scale.

Some attention has been directed towards the reduction of dust contained in the atmosphere, but not much has been accomplished in this direction. Public attention and scientific observation have been mainly diverted towards the limitation of visible smoke, ignoring the dangers and discomforts arising from the accompanying volume of fine ash which is discharged by all power plants and by the chimneys of heating apparatus.

Recently developed devices for catching dust or ash present a promise of effective dealing with this problem. The reduction of contamination of the atmosphere should be corrected at its source. These considerations, however, do not detract from the desirability of the purification of air introduced into buildings.

Air Conditioning

Directly connected with the process are the developments in method of cooling the interior atmosphere, in which direction some installations have been successfully operated. Some of our members will recall with satisfaction their experience of the cooled spaces in the Blackstone and LaSalle hotels upon the occasion of our Society's annual summer meeting in Chicago during the scorching heat of 1912.

Perhaps more than any other phase of this important development of the art of ventilation is the relative humidity upon which so much of the comfort as well as the health of human beings depend. As a part of the system of air conditioning, it has great hygienic importance and places the subject of proper ventilation upon a high scientific level. Installations of this character are now to be found in successful operation in places of amusement and hotels, their use, however, being restricted largely to the summer months. It has yet to be understood by the public that health is as much to

be conserved, and that respiration requires as much safeguarding in closed buildings in winter, as in summer.

During the period covered by this review the use of oil-burning apparatus has advanced, with particularly rapid developments during the past few years. This source of heat production has had important effects upon the interior heating of buildings, by reason of its convenience and its ready adaptation to automatic control. Its use in domestic heating is destined to expand, due to these features and to the ceaseless activity of producers of oil, as well as the intelligent advocacy of the various forms of burners and of automatic control devices which are now on the market.

Gas, Oil and Electricity

The use of gas as a fuel for heating purposes has not advanced as rapidly as has the use of oil, due to the fact that the one is a raw or nearly raw product, and the other a refined and therefore more costly form of fuel, but this situation is destined to change as the extension of a supply of natural gas proceeds, which has taken definite form within the past few years. Nevertheless the consumption of artificially-produced gas even at metropolitan prices, may prove advantageous and economical in view of the simplicity and security of its supply and its utilization. It may not be inappropriate to state that the writer has used artificially produced gas at the prices established in New York City, for the past seven heating seasons in a business and apartment building, in which the expense of this fuel though more than double that of coal, has been economically justified by the circumstances under which it is consumed. These include the elimination of labor, the absence of ashes and of the handling of fuel, which has made it possible to utilize a valuable basement space for storage and workshop purposes, and finally, the great convenience of automatic control.

Some advances have been made in the production and in the use of electrically-operated heaters, which in spite of the cost of an expensively-refined form of energy, have been found in many places economically advantageous as auxiliary heating apparatus.

Establishment of Research Laboratory

Perhaps the most important and promising advance in the knowledge of the fundamental facts relating to heating and ventilation has been the establishment of systematic research which began to take form in 1917, when the subject was taken under consideration by our Society. In 1918 a committee was appointed to formulate a plan and method of prosecuting this important project, and at the twenty-fifth annual meeting of the Society, the work of research was authorized and started.

The results which have already been attained indicate the great importance of this line of study and investigation. Progress has already been made in standardizing the conditions of the processes of heating and ventilation. The determination of efficiency of various appliances has already laid the foundation for the future development of the art of heating and ventilation upon defined systems by the use of ascertained methods and reliable apparatus.

The work of the Society and of heating engineers in general has thus advanced along lines increasingly directed by accumulated experience, test, and information during the past twenty-five years, largely as a result of the labor of our interested members.

Finally, looking over the quarter of a century through which we have passed, it is evident that the arts of heating and ventilation have traveled far. But we may learn from our brief consideration of that progress, the conclusion that there lies before us a great field of endeavor and accomplishment. Devoted to the progress of the human race and realizing how much contribution we may make to the health and happiness of our fellow-creatures, we may well gather inspiration from the progress of the past quarter century, and with confidence move forward to greater achievements.