of value for which the present crude methods of heating in factories are responsible. While gas can supply heat so easily controllable that there is comparatively little waste in obtaining from it effective duty, with coal there is necessarily a large waste of heat. There is a large amount of heat wasted in effecting its combustion, and in driving off those volatile constituents which are useless where high temperature and pure incandescence are required. There is also waste of heat up the chimney and through stand-by requirements. There is waste of heat every time a fire is re-charged until once more favorable working conditions of the fire are obtained. With the gas as fuel, the heat can be directed exactly as needed into the furnace, and heat losses by radiation and otherwise, can be reduced to a minimum.

I do not say that coal can be entirely displaced in factories; but I claim that a large part of it could be. The point I wish to make is, that in addition to air pollution, our industries are largely wasting, by their crude methods of heating, parts of the substance of the country which are necessary—more necessary to-day than they ever have been.

If these statements are correct, it can readily be seen how vast an opportunity there is to benefit the country at large, if we are able in any appreciable extent to do away with this waste. In case of any doubt as to the practicability of accomplishing this result, I believe that when it is seen how much has already been done in developing gas appliances to supplant the crude methods still so largely used, our knowledge of possibilities will lead us to believe that we see only the dawn of a new era in industrial heating.

The manufacturer has his point of view in this matter. It is not sufficient to explain to him how the use of gas will benefit the community; it is necessary to show him that it is to his direct benefit as a manufacturer, to adopt the modern methods of using heat in his processes. Some of these advantages are:—

(1) Economy in space occupied by appliance, and in some cases the necessity and expense of a smoke stack is avoided; a practically unlimited choice of position for the furnace, which enables it to be brought into close proximity to the machine workers.

(2) No space required for storage of fuel, and no removal of ashes.

(3) Increase in output per cubic foot of factory space, owing to economy of space occupied by gas furnaces in comparison with coal furnaces.

(4) The constant and unvarying supply of fuel, of a uniform heat value, at a fixed rate.

(5) Labor saving—absence of stoking, storage and conveyance of fuel.

(6) Rapidity, and improved production, due to ability to precisely control working temperatures.

(7) In many cases a lower capital expenditure for installation.

(8) Cleanliness, which frequently assists in decreasing net labor cost.

(9) No interest to be paid on investment in fuel in storage.

(10) Reduced fire risk.

(11) No loss of material due to inability to check a high temperature instantaneously.

(12) Less repairs on equipment.

(13) Enormously smaller loss from articles or materials being spoiled by irregular heat.

When these points are taken into consideration, it is really astonishing how many instances there are where the total cost of manufacturing is less with gas than with coal.

The Use of Gas in the Manufacture of Munitions

The same causes which make gas valuable for ordinary industrial purposes apply with increased force to the manufacture of munitions. In England it is publicly admitted that the tremendous leap forward in munition manufacturing could not have been made without the use of gas. On this side of the water, while the need for gas was not vital, nevertheless gas has played an increasingly important part in munition making. At times it has been adapted solely because of the speed with which an installation could be made, but once in, it stays in, when the intrinsic merits of the fuel become known.

When munitions are mentioned, we naturally think of shells, and it is in the manufacture of shells that much of the gas used in munition works has been consumed.

In the manufacture of shrapnel, every shell has to be hardened and tempered in a manner similar to the treatment of tool steel. The end of the shell must also be heated in order to forge in the end, or "nose" it. Much gas has been used for this purpose, and also for heating water used for washing grease off the finished shell, and for melting rosin which is poured into the shell after it has been charged with bullets. Even the high explosive shells have required gas. It has been used in ovens for baking varnish on the inside of the shell and in some sizes, notably the six-inch, large quantities have been used in forges for "nosing in."

Comparatively large gas-fired annealing furnaces have been employed for the treatment of various parts of shells, rifles, etc. Many parts are heated in forges for various operations, some of these forges being even 25 or 30 feet high, which shows that gas is being worked into the heavier operations.

Although large quantities of gas have been used for the purposes to which I have referred, it is not contended that other fuels could not be used, but nevertheless for various reasons, gas has been preferred. In the manufacture of small cartridge cases, however, gas is almost a necessity, and to the best of our knowledge is the only fuel used in the intricate machines which turn out millions of small cases, every one of which must be treated with absolute uniformity.

Continuity of Gas Supply in Toronto

Gas was first supplied in Toronto on the 28th of December, 1841, and from careful investigation it would appear that, while there have been local stoppages due to frost, broken mains, etc., there has not been even a momentary interruption to the general gas supply to the city since that date, a period of more than seventy-six years.

Conclusion

I shall have failed in the purpose of this paper if I do not state definitely my conviction that each class of fuel available for consumption in Canada should be selected and appropriated for the purposes for which it is inherently and economically best suited, regard being had to the essential objectives of:—

(1) Limiting the necessity for importing fuel from other countries.

(2) Limiting as far as possible the use of high-grade gas coal, to the purposes for which the largest percentage of its efficiency can be usefully employed.

(3) Avoiding the use of fuel requiring a long haul wherever it is possible to secure a suitable substitute requiring only a short haul.