Scientific American.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS.

One copy, one year, postage included....................$3 20

One copy, six months, postage included.................... 1 60

Club Rates:

Ten copies, one year, each $2 70, postage included....................$27 00

Over ten copies, same rate each, postage included.................... 2 70

☞ By the new law, postage is payable in advance by the publishers, and the subscriber then receives the paper free of charge.

VOLUME XXXI, No 22. [NEW SERIES.] *Twenty-ninth Year.*

NEW YORK, SATURDAY, NOVEMBER 28, 1874.

Contents:

(Illustrated articles are marked with an asterisk.)

EXHAUST STEAM FOR HEATING PURPOSES.

In a previous article, reference was made to the gain to be derived from the use of a feed water heater, in connection with a non-condensing engine. It must be evident, however, from the figures given in that article, that the heater is far from utilizing all the heat that escapes into the exhaust. When water is converted into steam, a large amount of heat is required, which does not raise its temperature, and, not being shown by the thermometer, is commonly called latent heat. Thus, if a pound of water at the temperature of 60° Fah. is heated until it is evaporated under the pressure of one atmosphere, the temperature of the steam will be 212°; but the heat which has been imparted to it is as much as would have sufficed to raise the temperature of more than 7⅓ pounds of water from 60° to 212°. On the other hand, to convert this steam into water, a similar amount of heat must be abstracted, from which it will be seen that the exhaust steam—which only heats about an equal weight of feed water—parts with but a fraction of its heat. But, as before remarked, if the steam can be cooled sufficiently to convert it into water, or condense it, it gives up to the cooling medium all the heat that became latent when it was changed from water into steam. These facts have suggested to some the idea of turning the exhaust steam into places where it would be cooled and condensed, giving up its heat where it was wanted, as, for instance, in warming a building. The ordinary manner of effecting this is to turn the exhaust steam into heater pipes that are fitted up throughout the building to be warmed, and draw off the water of condensation, to be used for supplying the boiler. Under such circumstances, the exhaust steam encounters an increased resistance, in passing through the heating coils, and this has the effect of increasing the back pressure on the piston. In order to fix some limit to this increase of back pressure, it is usual to attach a loaded valve, opening into the atmosphere, to the pipe leading from the exhaust to the heating coils, so that, when the limit of back pressure is reached, the valve will rise and the exhaust steam will escape into the air. In order to diminish, as much as possible, the back pressure created by the passage of the exhaust steam through the heating coils, they require to be fitted up with the greatest care. Neglect of this precaution has induced many persons to abandon the use of exhaust steam for warming purposes. In the construction of the heating coils, the principal points to be observed are: First, to have sufficient area of pipe to permit the free passage of the exhaust steam; and secondly, to arrange the pipes in such a manner, with suitable traps, that the condensed water or air cannot accumulate in them, but will be continually drawn off. If these provisions are attended to, the heating pipes can be extended over a considerable distance, with but little increase of the back pressure. An example, representing the results of average practice, will illustrate the foregoing remarks more fully:

A non-condensing engine of 60 horse power, exhausting into the atmosphere, had a back pressure on the piston of 1 pound per square inch. The feed water was pumped into the boiler at a temperature of 65°, and the average pressure of steam in the boiler was 75 pounds per square inch. At this pressure, the boiler evaporated 6¾ pounds of water per pound of coal, the price of the coal being $6.50 per tun of 2,000 pounds. The consumption of coal was at the rate of 4,450 pounds per day, costing about $14 46. The factory in which the engine was located was heated with steam supplied by the same boiler, requiring a consumption of 1,000 pounds of coal per day, costing $3 25, so that the total cost of fuel was $17.71 per day. These facts having been ascertained by careful experiment, the heating arrangements were changed, in the manner described below.

A few of the connections about the heater pipes were altered, for the purpose of obtaining more direct circulation, a trap of improved form was attached, a back pressure valve was put on the exhaust pipe, arranged to open at a pressure of 3 pounds per square inch above the atmosphere; and this pipe was connected with the heating apparatus, and a damper regulator was put in. It was found that, on account of the increased back pressure, the cut-off of the engine had to be adjusted so as to admit steam for a greater portion of the stroke, so that the engine required about 12 per cent more steam. If this had been the total result of the change, the effect would have been to increase the coal consumption 12 per cent, in addition to the expense of the alterations. It was found, however, that the exhaust steam from the engine heated the building quite as well as, if not better than, this was formerly effected by live steam from the boiler; and the water of condensation was led into a tank, from which it was used to feed the boiler, being taken by the pump at a temperature of about 200°. The boiler, being no longer required to furnish steam for heating purposes, and being fed with hot water, gave much better results than before, the damper being generally partially closed—so that the consumption of coal was only 4,100 pounds per day, costing $13.33, the saving in the coal bill per day being $4 38.

Such extensive alterations are not often required as were necessary in this case, where all the arrangements seemed to be made with the intention of wasting fuel. The gain, of course, after making the change, was proportionately large, but the expense incurred was considerable. In many places, the exhaust steam can be used for heating purposes, with very little outlay for alterations. Many heating coils, however, are put up in such a manner as to have very little circulation, and require a high pressure of steam to make them effective. Cases of this kind require extensive alterations before the exhaust steam can be turned into them. But there are numerous owners of small engines and boilers who have small shops which they can easily heat in the manner described. Our hints will probably be sufficient for such ordinary cases, but it is impossible to lay down general rules for every case.

PRISON REFORM.

As evidence of the urgent need of the reform in prison management suggested in our article on "The Scientific Treatment of Criminals," a friend in St. Louis sends us a printed account of recent doings in the State Penitentiary of Missouri, the horrid details of which remind one of certain parts of Charles Reade's "Never Too Late to Mend." For the credit of humanity, we should be glad to believe the story a gross exaggeration. If the half is true, the officers of the institution (and its management as well) would be benefited by a personal experience of the foul food, floggings, blind cells, and other abuses which have driven the convicts into rebellion, to be administered, not vindictively, for that would be contrary to the scientific method, but educatively, so that they might understand what manner of motives they are employing for the discipline of the prisoners and the probable moral effect of them.

Knowing the brutal and brutalizing practices that prevail even in institutions which have the name of being well conducted, we can understand how keepers such as our correspondent describes may, through ignorance, fear, and passion, aided by a thoroughly perverse system of prison employment, gradually convert a penitentiary into a school of vice and vengeance, rather than a place for penitence and reformation. We appreciate, too, the crying need of a radical change in the management of all such institutions: but that the prison system of the country can be made what it should be, by any burst of individual enthusiasm, we very much doubt. It may be true enough that that there is a "noble band of Howards" ready to undertake the reform "at the call of the American people": the hitch lies in the indisposition of the people to make the call. Not until the masses—upper as well as lower—have been educated up to the scientific level, and have learned to consider social problems as scientific problems, to be solved on scientific principles, will they be able to treat this question dispassionately and wisely. When that time comes, there will be little need of Howards to stir the sensibilities of prison keepers.

To the question: "Can you not set some means at work to release these thousands of mismanaged criminals from the pernicious system which thwarts their reformation?" we can only reply that we have already, to the best of our ability, set such a means at work, and that is the SCIENTIFIC AMERICAN. It does not set itself up as a mouthpiece of social or moral reform; yet, by spreading abroad the results of scientific research, by familiarizing the reading public with the spirit and methods of scientific thinking, it is doing its share toward educating the community up to the level required for the scientific consideration of all questions of social policy—the prevention and cure of crime with the rest. The process is necessarily slow; but the appreciative responses that have been made to our bare suggestion of a scientific treatment of criminals—an idea that could not have been entertained a few years ago—are proofs that progress is being made in the right direction.

A POSSIBLE IMPROVEMENT IN HOUSE HEATING.

At this delightful season of genial sunshine and crisp cool air, we have a daily illustration of perfect, because healthful and intensely enjoyable, heating. While the lungs are regaled with an atmosphere which seems to stimulate every pleasurable sense and activity of the body, the sunshine warms without oppressing, and heightens our enjoyment of the sparkling air by force of contrast. If we could imitate—much more if we could reproduce—the same conditions indoors, it is obvious that the perfection of house heating would be attained. Can either be done?

First, let us notice what the conditions are, on a sunshiny day of fall or early winter, that is, the conditions which combine to make such weather so refreshing. Pure air is practically transparent to radiant heat. In summer time, the high temperature of the air comes as an indirect effect of the heat of the sun. The sun rays heat the earth and the objects on its surface, and these, by contact or otherwise, heat the air. In the fall, the period of daily sunshine is briefer and the sun rays fall more obliquely. The ground is heated less, and the nightly periods of radiation are proportionally longer. The air in consequence remains cool throughout the day. Nevertheless, when the sun rays strike our bodies and are absorbed, their heating power is almost as great as in summer, giving us the simultaneous sensation of vivifying warmth, with delicious coolness in the air we breathe. Pass indoors from such an atmosphere to that of a furnace-heated house. How great the change! The air seems stifling, and though the temperature of the room, as recorded by the thermometer, is much higher than that outdoors, the pleasant glow which was felt in the sunshine soon gives place to an extreme sensitiveness to chill. Sit near a wall or a window, and an unpleasant coolness creeps up the back, as though a cold wind were blowing across it, and we look for a draft, though the air is motionless.

The conditions of perfect heating have been reversed. The air is at dog days heat. The walls and furniture are cold. The bodily heat is depressed by breathing the hot air, yet streams of heat must flow out from us in all directions to make up the deficiencies of surrounding objects. The thermometer may declare that such a room is warm, but every nerve declares that it is not comfortable. Substitute for the furnace an open fireplace with a blazing fire. An approach is made toward perfect heating. The radiant heat passes like sunshine through the air without heating it; and if the fire is so placed that its radiations impinge on a considerable area of the enclosing walls, the walls will be warmed as they cannot be by hot air; the furniture will be warmed in like manner, and the occupants of the room will enjoy the cheerful influence of live heat while having sufficiently cool air to breathe. The great expense and inconvenience attending open fires must ever greatly restrict their general use. Only about one tenth of the heating power of fuel is developed by its combustion in an ordinary fireplace, and much of that escapes unused. Besides, to heat a room of considerable size uniformly, it would be necessary to have an open fire at each side, or better, at each corner; an arrangement not to be tolerated as a matter of economy.

To burn fuel economically, it is necessary to burn it centrally and in mass. The coal that would supply a number of separate fires would furnish an immensely greater amount of heat if burned in a single furnace, a fact more or less recognized in every contrivance for heating houses by hot air, hot water, or steam. But in all such arrangements it is deemed essential to distribute, not heat directly, but matter more or less highly heated. In other words, we first heat our air or water, and trust to the cooling of that to furnish the heat required, overlooking the well known fact that heat will travel alone quite as well as in company, and that it can be much more easily controlled than air or water.

Radiant heat, the sort required for perfect heating, obeys the same laws as light. By proper arrangements of reflectors and lenses, heat radiations can be massed into beams of parallel rays and sent where we will, with little or no wasting. It is not until the radiations are arrested that they become manifest as heat; a fact put to practical use two thousand years ago, when Archimedes burnt the fleet off Syracuse with mirrors. A stream of heat vibrations, intense enough to fuse gold, would pass through a tube of ice without affecting it, provided the air in the tube be sufficiently pure and dry. There appears to be no good reason, therefore, why we should not warm our houses by the direct distribution of pure heat, and so gain all the benefits of an open fire in each room, with none of its disadvantages.

Briefly described, the plan would involve (1) a central fur-

© 1874 SCIENTIFIC AMERICAN, INC.