of concentric cylindric

chests within each other

(fig. 24), filled with

steam, and allowing air

to ascend by the sides

and through the inter

vening spaces, so as to

be made warm, and

the outer surface radia

ting directly on the sur­

face exposed. It may be

tubular, and coiled in

a large quantity in a

small box fitted up exter

nally in the appearance

of a cabinet or pedestal

in the apartment, thus :

(Figs. 25 and 26) ; the

feed pipe commencing

at the top of the coils,

and the return pipe passing off from the bottom. As the conducting power of tin is nearly equal to that of iron, a quantity of tin pipe will suffice, and be more economical than iron or copper. This coil may be placed in a eabi net or pedestal of the form of Fig. 26, and the warm air will have free egress through the wire work of the panel.

The next diagram (Fig. 27,) shows an arrangement of copper steam-vessels, by which an extensive surface is very efficiently exposed to the air, the condensed water being drawn off at the bottom.

There is one case in which warming by steam may be employed with especial advantage, and where it is frequently neglected—where the power of steam is already employed to drive machinery. Let the engine employed be what is called high-pressure, or non-condensing, in which the steam escapes from the engine and is passed off into the air ; and, instead of the common plan, let the steam from the engine be conveyed in pipes through the apartments to be warmed, and let the diameter of the pipe

gradually increase towards the end of its circuit, and finally terminate in a hot-water pipe, which may also circulate in the building and there will be given out the whole original heat of the steam after having done its work in the steam engine, and that as effectually as if there had been no steam-engine at all, and the whole power of the engine will thus be clear saving. This will be the case to a still greater extent if the steam-engine work expansively, and may further be increased if the pipes be so formed as to constitute an aerial condenser. For further information on this subject see article Steam-Engine.

2, *Warming Hothouses, Greenhouses, &c. by Steam.*

67∙ The principles which regulate this application of

steam are similar to those mentioned already in Art. 66, and steam possesses the same advantages in the distribution of heat for this purpose, which it does in the cases already mentioned. The warmth thus distributed is freed from those risks of injury to the vitality of the plants, which accompany the old method of warming by hot air flues, in which a contaminated and unwholesomely dry air and unequable temperature were inevitably produced, and an occasional annoyance from smoke. The warmth given out by the steam is of uniform intensity throughout the whole length of the glass ; it occupies very small space —one furnace and chimney is all that is required for any extent of range of glasshouses, as the steam may be conveyed to any usual distance in well swathed pipes without sensible loss. The saving thus effected by the concentration of the fire, and by its equable distribution, has been found to produce an economy of more than one-third of the fuel commonly used. At Sion House, the seat of the Duke of Northumberland, there are nearly a thousand feet in length of glasshouses heated by one such apparatus. The boiler and chimney may also be placed at a convenient distance from the houses—a circumstance which contributes much to the beauty of this arrangement.

Those who wish to study the details of this subject are referred to Mr Loudon’s Horticultural Works, and to the article “ Horticulture**,”** in this Encyclopedia. The fol lowing are the mechanical principles and arrangements that belong exclusively to this article.

Our first subject of enquiry, is into the amount of heat requisite to sustain the glass at a given temperature higher than that of the external air ; if we take the temperature of the atmosphere at 35°, and that of the hot house at 65°, giving 30° of difference, we shall have a case approaching near to that of a glasshouse in winter. In order to determine this question, which can only be as certained by experiment, the author has examined a case upon a large scale, which may furnish a standard of comparison.