

Third. In general, it is proper to take care that the whole of the force be employed to the greatest advantage in producing the intended effect; and also that no part of it be wasted on effects foreign to the intended purpose of the machine. Thus, in the lever, if the power act obliquely to its arm, a part of the power will be lost in pressing it against the point of support, with a useless consumption of force to the mere detriment of the machine.

Fourth. When a weight is raised by means of a crank, the mean arm of the lever may be considered as constant, and equal to $\frac{7}{11}$ of the breadth of the crank. Combinations of two, three, or four cranks, variously disposed on the same axle, are sometimes made use of. When four are disposed at right angles to each other, very little power is lost. The single crank is of great use in practical mechanics, and its power is as given above. The investigation is too difficult to be here inserted; it may be made out however in the manner given in FENWICK'S ESSAYS; and a complete demonstration is given in VENTUROLI'S MECHANICS.

Fifth. Simplicity in the construction of machines cannot be too strongly recommended; for a multiplicity of parts, or a variety of motions, increases the expense of erection, augments the friction, and increases the danger of breaking. To reduce a complex machine to a simple one, we must construct the various parts of the simple machine so that the velocity of the impelled point may be to that of the working point in the same ratio as in the complex machine; then the efforts of these two machines are the same in *theory*, but in practice the simpler will be much less subject to friction and accidents.

Notice of a "Treatise on Heat, and its Application in Arts and Manufactures. By E. PECKET." 2 vols. with plates. Paris, 1828.

[From the Foreign Quarterly Review, published in London.]

WHATEVER consequences may have resulted to France from the memorable occurrences of which she was the theatre at the close of the last century, the national industry received an irresistible impulse, which has carried her forward, ever since, in the career of improvement. The coalition which deprived our Gallic neighbours of all external resources, threw them back upon their own. The effect was magical; arts and manufactures sprang at once into no feeble and infantine existence, but like Minerva from Jupiter's brain. This may be attributed, in great measure, to the subversion of one among many other usages inseparable from antiquated forms of government—the selection of persons from every other cause than merit, to fill responsible and arduous situations. Necessity reversed this procedure in France; talent was cultivated, ability put in universal requisition, and science judiciously employing what were, apparently, the most unpromising materials, almost instantaneously rendered the nation independent. Never did philosophy hold so exalted a rank as when she thus answered the call of patriotism. From

that moment to the present, works have been issuing from the Gallic Press, which developed new principles in every department of science, and directed the application of them, or suggested new processes to modify and improve such as were already known. M. Péclet's treatise belongs to the latter class. The first volume details, 1. the physical theory of heat; 2. the theory of combustion and combustibles; 3. the theory of the movements of heated air; 4. the theory of chimneys. The second volume contains the application of the above—1. vaporization; 2. distillation; 3. evaporation; 4. drying; 5. heating of elastic fluid; 6. heating of liquids; 7. heating of solid bodies; 8. cooling. The author has made very many and ingenious experiments, the results of which prove that an alteration, which we shall hereafter notice, is required in the numerical values of certain terms in the formulæ hitherto employed. There are, besides, many interesting particulars in the book, as will appear in the course of the present article. But the writings of Tredgold and others of our distinguished engineers, have been, of necessity, so incorporated in the work, that, to an English reader, there is nothing new beyond what we shall extract. The total suppression of Dr. Black's name, while his theory is adopted, we regard as a compliment, implying, as it does, his merits to be so generally known, that any notice of his labours must be superfluous. We speak this with sincerity; the candour with which M. Péclet acknowledges the various sources of his information, is so rare among his countrymen, that we point out this instance of it with peculiar pleasure. The following is an ingenious application of a well known fact:—

“The force with which solid bodies tend to change their volume by the variations of temperature, is very considerable. Mr. Molard, former director of the Museum of the Arts, applied it with success. The two side walls of one of the halls of the Museum, had bulged outwards, from the pressure of the vault they supported. To bring them back, Mr. M. pierced the walls with iron bars terminated externally with strong nuts; by screwing up these, the walls could be prevented from a greater divergence, but it was not possible to bring them back to their original position. One half of the bars was then heated by means of lamps placed beneath them; these were consequently lengthened, the screws could be tightened, and the walls were partially brought back. By repeating the operation, the total restoration of the walls was effected.”

Admitting, as we do, the theoretical correctness of Saussure's hygrometer, we were much astonished at the author's high opinion of its practical utility; Despretz having shown from numerous and direct observations, that not the least reliance can be placed on its indications. The blind acquiescence, likewise, with which Sir H. Davy's explanation of the theory of his safety lamp is received, seems unaccountable, a more satisfactory hypothesis having been given by an Italian philosopher, M. G. Libri, of Florence, who ascribes its effect to the repulsive force of the metallic wire forming the gauze, not allowing the flame to pass through its interstices. The relative quantity of radiant heat which alone is applicable to domestic pur-

poses, from different combustibles, has been variously stated, some authors estimating it at only a few hundredths of the total heat disengaged; the subject received M. Péclet's especial attention; the apparatus he employed it is needless to describe; the results are as follow:—With wood, the quantity of heat dispersed by radiation, is to the total heat developed : : 1 : 3.74. The quantity of radiant heat is to that carried off by the chimney : : 1 : 3. With charcoal, these proportions are respectively 1 : 2.36 and 1.236 : 1. With coal, these quantities were not determined, from the difficulty attending the experiments; it is, however, conjectured by the author, that the power of radiation is superior to that of charcoal, and that with coke it is very much more so. With peat, and the charcoal from it, the approximate ratios are 1 : 2.6 and 1 : 1.6. From the superiority of the apparatus employed, and the care bestowed on the investigation, these results may be received with confidence. Of the formulæ hitherto, with but few exceptions, universally adopted for ascertaining the velocity of heated air, it is remarked that they are not at all exact; they assign

“For the height of the column which generates the velocity, the difference between the column of cold external air, and that of the column of warm air reduced to the density of the external air; but the velocity thus obtained is that which cold air, subjected to the same pressure, would have, and not that of the warm air. The difference may be considerable, for in the example we have selected, the velocity of the warm air is in value 19.18, while calculated according to the preceding principle, it would be only 16.33 metres.”

If then h represent the height of the column of heated air, t the external, and t' the internal temperature, m the dilatation of air for each degree of the centigrade thermometer, the height of the column of cold air reduced to 0° is $h \left(\frac{1}{1 + t m} \right)$ and at the temperature t' is $h \left(\frac{1}{1 + t m} \right) (1 + t' m)$ consequently the height of the column which generates the velocity, is $h \left(\frac{1 + t' m}{1 + t m} - 1 \right)$ and v , the velocity given by the formula, $= \sqrt{2 g h \left(\frac{1 + t' m}{1 + t m} - 1 \right)}$ whereas v , as assigned by Tredgold and others $= \sqrt{2 g h \left(1 - \frac{1 + t m}{1 + t' m} \right)}$ which values, differing only in the last factors, will be to each other as these factors : : $\sqrt{\frac{1}{1 + t m}} : \sqrt{\frac{1}{1 + t' m}}$. Various philosophers, M. d'Aubuisson in particular, have investigated, by different methods, the resistance air meets with in passing through pipes; M. Péclet subjected the matter to direct experiment. “For that purpose I got chimneys constructed of pottery, sheet-iron, and cast-iron. I varied the diameter and height of them, and the temperature of the air which circulated through them, and I have determined with

great precision the time which the air required to pass through them, from whence I easily deduced the velocity of the air in each particular case. Then comparing the numbers obtained by experiment, I perceived that the resistance to the passage of warm air through channels, was proportioned to the length of the latter, but inversely as their diameter, and directly as the square of the velocity; and I have ascertained the factor by which the velocity assigned by theory is to be multiplied to obtain the actual velocity."

The regular series of experiments was made upon cylindrical chimneys; detached observations, however, upon rectangular ones, indicate that the laws are the same for both, while for those that are compressed, it is only necessary to take the smaller diameter. The factor, then, by which the velocity assigned by theory is to be multi-

plied to obtain the real velocity of pure heated air, is $2.06 \sqrt{\frac{D}{L + 4D}}$

for baked earth, D being the diameter, and L the length of the canal

— $3.25 \sqrt{\frac{D}{L + 10D}}$ for sheet-iron—and $4.61 \sqrt{\frac{D}{L + 20D}}$ for cast-

iron. If the air is to be considered as half burnt, these quantities respectively, are to be multiplied by 0.97, a term depending on the chemical alteration which influences the density of the air in that state. This is a valuable contribution to practical science, and we trust that it will not escape the attention of the engineers in this country, engaged in the construction of works for which great heat is required. With respect to chimneys, a subject on which no difference of opinion as to theory exists, but the execution of which being unfortunately left, for the most part, to mere builders, comparatively ignorant men, occasions much annoyance in private houses, and serious loss in larger establishments, we found nothing new in the work before us.

An improvement introduced by M. Gourlier, in the Exchange in Paris, having obtained a patent in this country, we rather think the patentee did not anticipate the French architect, but do not recollect the precise date of the specification. The improvement consists in employing grooved bricks of different forms, so that the joints may cover each other, which, when united, may form cylindrical channels of nine or ten inches internal diameter, of sufficient size, consequently, for the purpose of heating and ventilating the apartments, and which may be introduced into the thickness of the walls without impairing their strength. The most valuable inventions and improvements in the arts in England, are not such as meet the public eye. There is too much clashing of interest, too great competition among the manufacturers, to allow of this, and the jealousy with which they regard each other, extends, in a stronger degree, to foreigners. Strangers, therefore, who feel the superiority of England, and while seeing the effects of our national industry, estimate the means of their production by published accounts, invariably overrate our artisans or undervalue our engineers—the former, for executing so much with what are described as not the most perfect

apparatus; the latter, for apparent neglect or ignorance of the support which science affords to every branch of art. M. Dupin, from personal experience, judged more correctly. M. Péclet does not run into either extreme; he speaks highly of the great English establishments; regards, for example, with astonishment, the Scotch distilleries, where, by employing alembics, about 44 inches in diameter, and 5 inches in depth, or from 52 to 54 inches in diameter, and about 8 inches in depth, their contents, 44 and 80 gallons respectively, are heated, completely distilled, and the alembics refilled; the first in two minutes and a half, the last in three minutes and a half; but he seems to think that theoretical refinements are too much overlooked. Now, it is precisely in these details that wholesale operators vie with each other, and it is these secrets which would be, and are, most jealously guarded from every eye. The consequence is, that books on practical subjects are necessarily in arrear—the initiated will not speak, the uninitiated are unable to do so; and M. Péclet, as well as the rest, in describing the various processes connected with heat, has done nothing more than afford the reader a general idea of the means and mode of proceeding. For this, we refer to the work itself, which will be found a valuable addition to every library, and shall insert only a few particulars, which, to us, appear interesting. Having spoken of the calcareous concretions which form on the bottoms of boilers, and used to occasion much inconvenience, he proceeds:—

“A simple and very efficacious method is now known of preventing the incrustations in question; it is to add from 26 to 33 pounds weight of potatoes to the water in a boiler which consumes from 55 to 66 pounds of coal per hour; the boiler may then be employed for 20 or 30 days without being cleaned, and without any fear of a calcareous deposit. After this time the mud must be thrown away, and the same quantity of potatoes again be added. It appears that the fecula, by dissolving in the water, renders this sufficiently viscous to prevent the deposition of the calcareous matter. Flour would produce the same effect, and much less of it would be required.”

The following is the most striking instance of its kind that we have met with, which shows how easily the presence of extraneous bodies in boilers tends to injure them.

“A few days after the steam boiler designed to heat the Exchange in Paris was brought into use, it was perceived that there was a hole in the bottom. The fire was extinguished, and it was found, upon emptying the boiler, that the metal was burnt in a place where a rag (*chiffon*,) had been deposited, which had been forgotten when the apparatus was set up.”

Our countrymen, who regard with such pleasure the cheering blaze of their domestic hearth, will learn with regret, that, “of all the modes of warming houses, the very worst are open chimneys, then stove-grates, then stoves.” The fact is, that in England we regard the appearance of comfort almost as much as the reality, and are frequently content to make some personal and pecuniary sacrifice, sooner than forego the pleasure of *seeing* our enjoyments. Paradoxi-

cal as it may seem, a person acquainted with human nature will find both sound sense and economy in this, while the heartfelt results of our personal experience will render nugatory the cold calculation of philosophy. But taking into account the national habits, we doubt if any other system of warming houses can be introduced into England than that at present in use. M. Péclet may laugh, as we do ourselves, at Dr. Arnott's absurd speculations in the construction of grates, and the ridiculous monstrosities of Messrs. Atkins and Marriott; he may denounce, and justly, the inordinate and preposterous capacity of our chimneys; but the former are not to be considered as standard specimens of British ingenuity, and the defects of the latter, long since signalized among ourselves, are gradually disappearing in a more rational style of architecture. For large establishments, steam may be employed with advantage; under some circumstances the adoption of stoves may be desirable; but for the general purposes of English domestic life, the open fire-place is indispensable. Nor, adopting the data given by M. Péclet, is any loss of fuel occasioned thereby, when all the purposes for which it is required are taken into account, and the construction that of our best manufacturers. Nations, if not individuals, will gradually improve, as they adopt what their necessities require, anticipating by their practice the suggestions of theory.

"Among the worst conductors must be ranked air, when it is perfectly at rest. Hence, one of the most efficacious means for retarding bodies from cooling, may be easily conjectured, which consists in surrounding the body with one or more envelopes, at a distance from the body, and from each other. The strata of air surrounding the body and its envelopes, without being able to escape, will allow the heat to escape only with extreme difficulty."

Now, this is an exact description of a Chinese tea-pot; a cylindrical metallic vessel closely stopped, inserted in a square wooden box, of at least double capacity, with a cover accurately fitted, and a small orifice in the side, through which the minute aperture of the spout appears. If water boil when poured into this apparatus, more than twenty-four hours are required to cool it.

The mathematical theory of heat, so powerfully developed last year, by M. Fourier, of the Institute, is not alluded to in the present work. To this subject we shall return at a future time, and in taking leave of M. Péclet, equally admire the ingenuity he has displayed in his own researches, and his judgment in applying the labours of others.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS GRANTED IN JUNE, 1829.

With Remarks and Exemplifications, by the Editor.

1. For *Manufacturing Woollen Cloth suitable for Carpeting, Floor-cloths, Rugs, Table-covers, Blankets, Padding,*