

The tissues of M. Solier are prepared not with natural caoutchouc, but with artificial caoutchouc, of which MM. Barrat have made so many successful applications, and which is prepared by oxidizing drying oils either directly or by aqua fortis. Nothing is more permanent or more workable than this remarkable substance, said to have been discovered by Liebig. To convert it into a material fitted to be used as a coating for stuffs, M. Solier mixes it with a certain quantity of resin-oil, purified by the process of M. Mangeot. The stuffs coated with it are perfectly impermeable, supple, light, and unalterable by light or air; and what is their greatest merit, may be made astonishingly cheap. They are accessible to the poorest classes; and thanks to them, the humblest laborers in our fields will not be exposed hereafter to suffer from the weather. The most delicate silk and the coarsest woolen fabric are alike susceptible of this preparation.—*Cosmos*, vol. v. p. 570.

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*On the Mechanical Equivalent of Heat.* By M. PERSON.

The mechanical equivalent of heat, that is to say, the work done by an unit of heat, if there be no loss, has been very differently estimated. M. Mayer found it to be 360 kilogrammètres, M. Laboulaye 110, and M. Joule 427. Lately M. Estocquois, my colleague in the Faculty of Sciences, obtained the number 175, in a Memoir which he had the honor of presenting to you.

We shall have the exact number, when we know exactly the specific heat ( $c$ ) of air, under constant volume, or rather without external resistance. But, in the meantime, it is perhaps worth while to remark, that the value of  $c$  deduced from the formula of Laplace for the correction of the velocity of sound, gives for the mechanical equivalent of heat a number differing very little from that assigned to it by M. Joule.

Air which dilates without external resistance, recovers in a few moments its primitive temperature, and contains, despite its dilatation, neither more nor less heat than before. This principle, as to which doubt might still have been entertained even after the experiments of M. Joule, is now perfectly established by the last experiments of M. Regnault.

Starting from this principle, the mechanical equivalent of heat is deduced by very simple reasoning. Let us consider one cubic metre of air at  $0^\circ$  temperature under the normal pressure ( $H$ ) kilogrammes per square metre; let  $p$  be its weight,  $c$  its specific heat under constant volume. If we give to this air the heat  $pc$ , without suffering it to dilate, the temperature will rise one degree, and the pressure will become ( $H_a$ ) ( $a$  being the coefficient 0.00367.) Let us now open a communication with a vacuum; we shall have the same temperature, and the same quantity of heat, in spite of the dilatation, and if the vacuum is equal to the fraction  $a$  of a cubic metre, the pressure will become  $H$  again.

Let us now take a cubic metre of air, at the temperature  $0^\circ$ , and under the pressure  $H$ ,  $c$  designating its specific heat under constant pressure;

give to this air the heat  $pc$ , permitting it now to dilate under the pressure which it supports; we thus obtain a volume  $Ha$  at  $1^\circ$  under the pressure  $H$ , precisely as in the last case, where, however, we only introduced the quantity of heat  $pc$ . In the first case no external work was done, whilst in the second, the dilatation  $a$  against the resistance  $H$ , produced the work  $aH$ . As these two masses of air were identical at the beginning, and are so at the end, neither of them contain more or less heat than the other. We may therefore conclude that the heat  $p(c-c)$  is *alone and entirely* employed in producing the work  $aH$ . Therefore, the work done

by an unit of heat is measured by  $\frac{aH}{p(c-c)}$ .

Substituting the numbers  $H=10334^k$   $p=1\cdot293$   $c\left(\frac{279}{333}\right)^2=0\cdot1686$ ,

according to Laplace, and  $c=0\cdot2377$ , according to M. Regnault; we find 424 kilogrammètres for the mechanical equivalent of heat.

Observe, that  $p(c-c)$  is the difference of two specific heats for equal volumes. Now, according to Dulong, this difference is the same for all gases, simple or compound. This accords very well with the idea of invariability which attaches to the mechanical equivalent of heat. But, as M. Regnault has demonstrated that  $a$  is not rigorously the same for all gases, it follows that  $p(c-c)$  must vary proportionably by a very small amount. We may, moreover, assume that the specific heats have been measured so far from the point of liquefaction that there is no change in molecular constitution, so that the effects of the heat are confined to variations of temperature, and extraneous work.—*Acad. des Scien., Paris, December, 1854.*

### *Photographic Pictures on Stone for Lithographic Printing.\**

In France, the fascinating art of photography has for some time been applied in the process of multiplication by printing on stone, and hence its industrial value has been increased by one great step beyond what we have achieved here. Messrs. Lemercier & Co., of Paris, who have carried this art to great perfection, give the following instructions for practising it. To obtain a photographic picture on stone, in a manner suitable for lithography, a substance must be had which can be placed upon a stone in a regular and uniform film, and which can be acted upon by the light in such a manner that the lights of the picture may be dissolved away and the half tints separated, whilst it must adhere to the stone sufficiently to prevent its being removed either by the solvent or by the subsequent printing process, it being, of course, capable of taking the lithographic ink. The bitumen of Judea, first employed by Niepce, is considered to possess all the requisite properties. It is, however, necessary to select the bitumen very carefully, as some samples are far more susceptible to the action of the light than others. A small quantity of the bitumen, reduced to a fine powder is dissolved in ether, the solution being so made that when it is spread upon the stone it will lie in a

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