

Indians eat rice; the West Indians, yams and bread tree; the Africans dates; in fact, a fraction, and that a very small one, of mankind are carnivorous.

The workmen employed in the iron-works of the Hainault, Liege, and the machine-making factories both of Seraing, Bruxelles, Ghent, &c., live on potatoes and vegetables, with a piece of meat among them, for dinner regularly; coffee of chiccory; and on the Sundays, spirits in moderate quantity. These are the best paid.

The workmen who come under the second class are the masons, blacksmiths, carpenters, &c. of the towns, the woollen factory and domestic weavers, who live nearly in the same manner, but consume either a less portion of meat, or take it only three or four times a-week.

The cotton weavers and factory workmen live less well. Potatoes and vegetable soup form their chief food, with bread half rye and half wheat; coffee and occasionally a glass of spirits, and commonly brown beer, are their beverage. This beer is particularly nasty, but, I believe, wholly free from *coccus indicus*, &c. &c.,—pure malt, hops, water, and salt, ill proportioned, and execrably boiled.

With regard to the prices of food, an able-bodied man will support himself comfortably on 7*d.* per day in Belgium, in the country. Bread, such as labourers eat, is about 1*d.* per lb. in the country; other food in proportion.

The price of grain was as follows, per hectolitre, or 22 gallons, equal to 2½ bushels.

| | 1834. | 1835. | 1836. |
|---------------|-----------------|----------------|-----------------|
| Wheat, white, | 13 fr. 19 cent. | 14 fr. 3 cent. | 15 fr. 56 cent. |
| Do. red, | 14 fr. 53 cent. | 15 fr. 8 cent. | |
| Rye, - - | 8 fr. 41 cent. | 9 fr. 4 cent. | 10 fr. 5 cent. |
| Oats, - - | 5 fr. 90 cent. | 6 fr. 57 cent. | |
| Potatoes, | 3 fr. 21 cent. | 3 fr. 90 cent. | |

The cottages of the country, peasants and artisans, are proverbially neat and clean, and so I universally found them; but my visits to the poor districts in Brussels presented a very different result. The houses where the poor live are dirty, close, crowded, and offensive.

TO BE CONTINUED.

NOTICE FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL
OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

Substance of some New Researches on the Disengagement of Heat by Friction. • By M. BECQUEREL.

Bodies are considered as formed by the union of an infinite number of molecules, or atoms, surrounded by heat which opposes their immediate contact, aside from all theoretical opinions of its nature. When the quantity of it increases or diminishes, the distance between the molecules becomes greater or less, and the volume of the body experiences corresponding variations.

It is admitted also that these same molecules are subjected to an attractive force which tends to bring them together, and which is consequently opposed to the repulsive influence of caloric. Finally a third force is allowed to interfere in the constitution of bodies,—the attraction of each molecule, for the heat which surrounds the neighbouring particles. When

the force of aggregation predominates over the two others, the body remains solid; if the heat increases, a period arrives at which the molecules acquire a certain mobility and the body becomes liquid. Eventually, if the quantity of heat becomes so great as to overcome the force of aggregation, the body assumes the gaseous form. The molecules of bodies being thus held at distances greater or less in proportion to the reciprocal action of heat and attraction, they must be separated by interstitial spaces in which the phenomena of light, heat, affinities and molecular attraction have been shown to operate. It is therefore in these spaces that the imponderable agents incessantly contend with the material principles of bodies.

Heat must act the principal part in this operation; for, according to its intensity and mode of action it produces light, electricity and the play of chemical affinities. It is obvious therefore that the properties of this agent cannot be too carefully studied in its relation to the particles of bodies, if we wish to arrive at a knowledge of its immediate influence in all that concerns natural phenomena of the most elevated order. These considerations have suggested the idea of a series of experimental researches which have led to some new results, which we shall endeavour to point out without going, as far as we might do, into technical details which it might be difficult to render perfectly clear in a rapid lecture.

Take a body at an equilibrium of temperature with the surrounding medium. If, by any cause whatever, this body be agitated so as to cause its molecules to lose their position of natural equilibrium, it is very evident that all the imponderable agents which existed in the intermolecular spaces will be put into motion. A multitude of phenomena would in consequence result, which the philosopher undertakes to analyze by the means which science has placed at his disposal. We shall confine ourselves at first to the effects of heat produced when friction is the mode of agitation made use of.

We know that when two bodies are rubbed against each other, heat and electricity are disengaged; are these two effects, which are concomitant, dependent, or not, upon each other? This we shall speak of hereafter. At present let us confine ourselves to the effects of heat.

All that we know of the production of heat by the mutual friction of two bodies is reduceable to this; the two bodies grow warm, and the quantity of heat emitted is sometimes so considerable as to inflame combustible substances. Thus a wheel turning rapidly on its axis takes fire, and the savage, with an address and dexterity that we are strangers to, inflames pieces of dry wood by rubbing them with great velocity against each other.

In all such cases we are led to the belief that the effect is owing to a vibratory motion of the particles produced by the friction, as the following facts tend to prove.

When an alloy, composed of one part iron and two parts antimony, is subjected to the file, bright sparks are immediately produced, showing that the temperature is increased to incandescence. The flint and steel exhibit the same effects.

Rumford, by boring a cannon placed vertically, obtained heat enough to boil water in a cavity made for the purpose of boiling it. This then is nearly all that we know about the disengagement of heat by friction. We are completely ignorant of the manner in which a body acts in the production of this phenomenon according to its own nature and the condition of its surface.

In order to determine how each substance intervenes, we must find the means of separating all the causes which mask or conceal the effects which

we have in view. Unhappily we cannot accomplish this in a perfect manner. In fact, when we rub two bodies against each other more or less rapidly without breaking the contact between them, there is evidently a transmission of heat from one to the other. The quantity transferred from each of them depends on the conductivity of the substance, on its capacity for heat, and on the state of its surface. On the other hand, the heat disengaged in a body cannot be detected immediately before its transmission into the other body, by means of the common thermometer, inasmuch as its indications are not instantaneous. Nevertheless, it is possible to operate under circumstances which allow us to remove some of the difficulties just alluded to, and we are thus conducted to a series of facts now to be described.

The apparatus for this purpose is composed of a thermometric pile in connection with an excellent multiplier. Its sensibility is such that a difference of about $\frac{1}{100}$ of a centigrade degree, in the temperature of the two faces of the pile, causes the magnetic needle to deviate so far that the angle becomes appreciable.

To reduce the question as much as possible to its simplest expression, we take two bodies of the same nature, bad conductors of heat, equal in all their dimensions, and differing only in the condition of their surfaces. These bodies are attached to glass rods. The rubbed surfaces are placed each in contact with one of the faces of the pile; when those two surfaces are of the same temperature the magnetic needle remains at rest, since the two thermo-electric currents being equal and in contrary directions destroy each other; but when the temperatures are not the same, the needle deviates immediately and the angle of declination shows the difference of temperature. The friction is produced with a velocity and pressure determined by the aid of a particular construction in order that its intensity may be always known; the two bodies are rapidly separated from each other and experimented with immediately.

The above is the process of manipulation,—we proceed to the results.

We commence with trying the effect produced on the needle by the contact of one of the rubbed surfaces with one of the faces of the pile, an effect arising from the heating of that face.

The experiment proves that whatever be the nature of the rubbed disc, whether it be a conductor or non-conductor of heat, the time required to cause the needle to deviate to a maximum of declination, provided that does not exceed 60° , is always $10''$. For deviations from 60° to 75° it is $9\frac{1}{2}''$, and from 75° to 90° it is $9''$.

The needle then acts in this case like a pendulum, oscillating under the action of gravity within small amplitudes, since the deviations are isochronous; but with this difference, however, that in the pendulum, when the amplitude of oscillation increases beyond a certain limit, the time of the oscillation increases equally; whilst the contrary occurs in the experiments now described; that is to say, the time diminishes as the amplitude increases beyond 60° and as far as 92° . This result is connected with the propagation of heat and electricity in bodies.

Let us now take two bodies of the same nature, equal, and disposed as above described; for example two discs of cork, one of which has a smooth surface and the other a rough one. If we rub them against each other in a determined and regular manner, and present them simultaneously to the two faces of the thermo-electric pile, the needle immediately diverges, and the direction it takes shows that the disc with a rough surface has acquired more heat than the other, and that in proportion to the rapidity of the fric-

tion. The same holds good when we rub a piece of polished glass against another which is unpolished. We have found the former to have gained one-half less heat than the second. Hence we perceive that the absorbing power of bodies exerts an influence on the disengagement of heat in friction. This rule, however, is not general, for white satin gives more heat than black satin which has a greater absorbing power.

When bodies of different natures are experimented with, the following results are obtained: 1st. Polished glass and cork,—the first gains more heat than the second in the proportion of 34 to 5. 2d. Unpolished glass and cork; the relation of temperature is as 40 to 7. 3rd. Silver and cork,—the first is heated more than the second in proportion of 50 to 12. 4th. Caoutchouc and cork,—the temperature of the first to the second is as 29 to 11, and so of others.

From the numerous results we have obtained in the friction of bodies of different natures, we are not able yet to deduce any simple laws on account of the various causes which concur to produce the general effect. It only appears that the nature of bodies, aside from conductivity, exerts an influence which the condition of the surface does not always destroy.

We have thus far found it impossible to ascertain the true cause of this influence which depends on the nature of bodies and probably on the arrangement of their molecules; but it is important to have shown this by experiment because it furnishes us with an additional element, which the theory of heat may hereafter take into view. Now, if we enquire into the relation which exists between the production of heat and that of electricity by the natural friction of bodies, the consequences which flow from recent experiments are these,—the displacement of the parts of the rubbed surfaces always gives place to a disengagement of heat and to a disengagement of electricity, two effects which have a reciprocal dependence; this dependence is so much concealed that it is impossible yet to affirm whether one precedes the other, and *vice versa*; we can only indulge in conjectures upon it, and these would induce us to believe that the heat is derived from electricity, when the bodies are of the same nature, slow conductors of heat, and differ from each other only in the condition of their surfaces: the surface which heat the most acquires negative electricity, and that which gains the least heat, the opposite electricity. When the bodies are different, the effects become very complex, and can be interpreted only by having the results before our eyes.

New facts may allow us to extend to light the relations partially discovered between heat and electricity. Phosphorescence affords this advantage. We know that this phenomenon manifests itself wherever the particles of bodies which are slow conductors of electricity are agitated by percussion, friction, heat, light, the electric shock, and also when decomposed by chemical action. These causes are precisely those which disengage electricity; now, the phenomenon being molecular, the recombination of the electricities disengaged around molecules must give rise to an infinite number of little sparks, the totality of which must produce a glow similar to phosphorescence;—whence we are allowed to infer that phosphorescence has an electric origin.

Of the source of the phosphorescence in the *Lampyreae* and *infusoria* we are ignorant, and if it proceeds also from electricity the important experiments of M. Ehrenberg will probably inform us. This able physiologist has just completed a careful study of the light emitted in the dark by the *infusoria* and *annelides* which render the sea luminous in certain countries,

particularly when a light breeze agitates its surface. Having placed on the porte-object of his microscope some water containing these animalcules, he was astonished to see that the diffused light which surrounded them was no other than the union of a multitude of little sparks which were emitted from all parts of their bodies, and especially from the bodies of the annelides. These sparks, which succeeded each other with great rapidity, had so close a resemblance to those observed in electric discharges, M. Ehrenberg did not hesitate to decide on their identity. He also assured himself that the light emitted is not owing to a peculiar secretion, but rather to a spontaneous act of the animal, and that it becomes manifest whenever it is irritated by mechanical or chemical means, viz. by agitating the water, or pouring in alcohol or an acid. How analogous is this to the torpedo, which throws out its discharges only when irritated? The animalcules also, like the torpedo, renew their discharges after a certain period of repose.

From this similarity of effects, under the same circumstances, can we do any other than conclude that there must be an identity in the cause? Now, in the torpedo, no one doubts, at present, that the cause is electricity; we must, therefore, admit that it is the same thing which produces the phosphorescence of the infusoria and the annelides. It is very remarkable that luminous phenomena, or others which depend on electricity, are so much stronger as the animals are smaller; and it would seem that this profusion of electric fluid emitted solely by beings of an inferior order is destined to supply other functions in beings of a more elevated order.

Is it not allowable to infer, from these facts, as Berzelius and other philosophers have advanced, that the light disengaged in combustion, which gives rise to so great a disengagement of electricity, is also but the result of the discharge of an infinity of minute sparks, produced during the combination of combustible bodies with those which are supporters of combustion?

We perceive then that the relations which connect light, heat and electricity are acquiring, from day to day, a fresh extension, and we learn that these three agents, which preside over the molecular constitution of bodies, are derived, according to all appearances, from a single principle, of an ethereal nature, diffused throughout space and in all kinds of matter.

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On the Supposed Influence which the Roughness and Polish of Surfaces exerts over the emissive power of Bodies. By M. MELLONI.

When we subject to measurement, the heat which radiates from a metallic vessel filled with boiling water, one of whose longitudinal sides remains well polished and brilliant, and the other roughened by emery, by the graver or the file, we find the quantity of heat thrown off by the depolished surface to be always superior to that which issues from the brilliant side; the difference sometimes exceeding the proportion of two to one. It is hence inferred that the observed increase of heat is occasioned by the superficial inequalities produced on the roughened side, and consequently that asperities on the surface of bodies, tend to facilitate the emission of their internal heat. I am about to communicate to the Academy a sketch of some researches, which, as it appears to me, plainly show that this supposition is entirely erroneous, and that if the superficial layers evidently contribute to vary the quantity of heat emitted by a hot body, the condition of the surface has no part in the production of the phenomenon.