figure. According to Hewson, Young, Hodgkin, Lister, and Queckett, their form is that of biconcave lens—a vesicle or cell, with thickened walls, in a collapsed condition; the coverings of the cells admit of transudation, and by the addition of water to blood, endosmosis takes place, and the corpuscles acquire the form of a distended cell, with thinned coats, and become so transparent as to be with difficulty perceived. Red corpuscles thus changed may be brought back to their original form, more or less, by the action of re-agents which are capable of inducing exosmosis. The enveloping cell is composed of a peculiar protein compound, closely allied to albumen, globulin of Berzelius, which is left in combination with sulphuric acid, by the action of that acid on coagulum; whilst the internal coloured portion is hæmosine, already sufficiently examined for our purpose.

When chlorine is passed through an albuminous fluid, chlorite of protein is formed, and precipitated in white flakes; by the action of ammonia on this compound, a new oxide of protein, mixed with hydrochlorate of ammonia, is produced; this is tritoxide of protein, (gelatin of Bouchardat;) it is also formed when fibrin or albumen is boiled in water. It is prepared in the lungs, and is consequently found in the blood, particularly in excited states of the system, as a main ingredient of the buffy coat. By dissolving this compound in potassa, and precipitating by an acid a second oxide, the binoxide (epidermose of Bouchardat,) is produced; this oxide is insoluble in water, while the former is soluble. It is probable that both these oxides are formed from the fibrin as often as the blood passes through the lungs; this is demonstrated by an experiment of Scherer: he found, by exposure of moist fibrin to oxygen, that the gas was absorbed, and carbonic acid given out, but that more of the former disappeared than was accounted for in the evolution of the latter; the loss he found to be expended in the formation of an oxy-compound of protein; for the fibrin, after this exposure, on being boiled in water, left binoxide of protein undissolved, while the tritoxide was found in solution. Valentin and Brunner show that hourly 69.0575 grs. of oxygen are absorbed, which are not employed in forming the carbonic acid of the expired air.

Mulder avails himself of most of these facts, (many of them his own discoveries,) in explaining the changes produced in the lungs by respiration. He presumes the bright red arterial blood corpuscles to be biconcave lenses, and therefore in a good condition to reflect a great amount of light; this concave form is in several ways materially influenced by the formation of oxy-protein taking place in the lungs; the contraction which will necessarily follow the formation of this "buffy" membrane, while the investing membrane being thus (as Emmert and Mayer have remarked) denser, whiter, and thicker, and consequently more opaque, will put them in a state more favourable to reflection, and necessarily heighten the colour. On reaching the systemic capillaries, the layer of oxidized protein is removed and decomposed, the protein being employed to repair the various structures, while as to the oxygen, we may adopt Liebig's opinion that it "serves to produce change of matter, and determines the separation of living parts, and their conversion into lifeless compounds, as well as the formation of the secretions and excretions." Deprived in this manner of their envelopes, the arterial become venous corpuscles, the light passes more readily through their coats, and is materially altered from the change they have undergone from the double concave to the double convex form.

Thus, then, the action of air on oxygen, or venous blood, is imputed to the absorption of the gas, not by the colouring matter, but by the protein, which is in consequence oxidized. Any agent which affects the form of the globules, and as a necessary result, at the same time, their reflecting power, in a corresponding degree alters their tint; for example, saline solutions produce exosmosis in venous blood. A consequence of this emptying is a collapsed condition, or concave form; and the arterial hue, for reasons previously stated, is assumed; while, on the other hand, washing this blood with water, or passing through it many gases, or treating it with dilute acids, induce endosmosis, and with this alteration of physical character is produced the venous colour. Doubtless the action of carbonic acid and dilute acids may be referred to the solution of oxy-protein; an alkaline fluid, in destroying the red colour, operates in a similar manner.

Scherer is inclined to hold much the same opinion as Mulder, that the difference of colour between arterial and venous blood depends rather on physical than chemical causes, and by his experiments tends to confirm similar views of Henle and Nasse. A quantity of fresh and bright-red blood was mixed with water; it became dark, in fact venous; and with the change of colour consequent on this dilution, the globules were found to have undergone a material physical alteration; they had lost their concave form, and had become spherical from the absorption of water by their coats. Neutral salts added to blood thus darkened

changes the form and colour of the corpuscles. The microscope shows that while carbonic acid causes the corpuscles to become spherical, oxygen reduces them to a hollowed form; in this case, doubtless, the mechanical action of the substance as a gas being interfered with by the chemical property it possesses in the formation of oxy-protein. If, through the mixture of blood and water previously spoken of, oxygen is transmitted, the dark colour still remains, in all probability on account of the absence of the necessary conditions for the formation of the firm covering; but if to it white particles, capable of reflecting light, as oil, milk, finely-powdered chalk, &c., are added, then the arterial hue is assumed.

The conclusions that Scherer draws from these and other experiments are, that as the addition of distilled water cannot deoxidate the colouring matter, while neutral salts cannot add oxygen to it, and the actual addition of that gas does not produce a red colour in the blood, the change produced in the colour *cannot be a chemical one*. If the act of respiration in the living body, and addition of neutral salts out of it, produce the same change in the colour of the hæmosine, it is possible that they both exert the same physical action as the envelopes of the blood corpuscles.

Thus, then, the opinions of both Mulder and Scherer are essentially identical, and account, in a satisfactory manner, for the phenomena of respiration; both agree in referring the whole to the different refraction and reflection of light produced by the several forms of the corpuscles assumed under certain conditions; Mulder considering that the change of form affords a sufficient explanation; Scherer, from his experiments, though he does not appear to deny the important part that form has to do with the change of colour, seems to think that the red tint depends additionally on the presence of white reflecting particles in the blood—in fact, chyle globules.

York, March 4th, 1845.

ON THE LAW OF ASSOCIATION BETWEEN SENTIENT AND MOTOR NERVES.

By I. PIDDUCK, Esq. M.D.

HOW DOES LIGHT IMPINGING ON THE RETINA EXCITE CONTRACTION OF THE IRIS?

In replying to this question, proposed by Mr. Stephens, of Bristol, the brain will be viewed as a whole, and the nerves as simple uniform cords of intercommunication between the brain and all parts of the body. The spinal cord will be considered as a prolongation of the brain; not as made up of separate parts, but consisting of one organ, composed of cortical and medullary substance. It is not proposed to lay aside the distinction between nerves of special sense, of sensation, of respiration, and of motion, but to regard the nervous cords as uniform in their structure. Their difference in function will be regarded as arising not only from the particular portion of the brain or spinal cord, from which they originate, but from the difference in the mode of termination, and the structure of the organs on which they are expanded.

The olfactory nerve, for instance, expanded on the nasal cavities, is sensible to the stimulus of odours; the optic nerve expanded into the retina is sensible to the stimulus of light; the auditory nerve expanded upon the cochlea and semicircular canals is sensible to the stimulus of sounds; the fifth pair, terminating in the teeth and cutaneous papillæ, is sensible to objects of touch; the portio dura of the seventh pair, terminating in muscular fibres, is conducive to muscular motion; and so of the third and fourth. But for any appreciable difference in the nerves themselves, it might be safely inferred, that if the olfactory, the optic, or the auditory nerve, had been distributed to the skin, they would have been nerves of common sensation, instead of being nerves of special sense; or if they had terminated in muscular structure, they would have been nerves of motion.

The fact that each of these three classes of nerves (or to adopt the fourfold division, by distinguishing the nerves of respiration from those of motion) has a separate and distinct origin, proves nothing; for this beautiful arrangement may have been designed for some other wise and beneficent end by the Great Author of our being, who is especially characterized as the God of Order. It may be that this arrangement may merely subserve the purpose of protection, transmission, and distribution of the nerves which influence the vital functions, which minister to our enjoyment and warn us of danger, and which excite muscular exertions for our defence.

Considering, therefore, that the particular property of the three classes of nerves depends, not only upon their origin, but upon their expansion or termination, the fact that muscular contraction follows the application of a stimulus may be explained as a *simple*

law of association, for the protection and preservation of parts from undue stimulation.

The iris contracts when light impinges upon the retina, and that in proportion to the sensibility of the retina to exclude the excess of light, according to this law of association. The contraction of the orbicularis muscle with copious lachrymation, in case of inflammation, or to dislodge any irritating cause from the conjunctiva, is another manifestation of this law of association, similar to the act of sneezing to expel any irritating substance from the Schneiderian membrane.

This law of association between sensation and motion seems to prevail everywhere throughout the body. It obtains between the nervous papillæ of the skin and the subjacent muscles; between the muscles of respiration and the mucous membrane of the bronchiæ; between the mucous membrane of the alimentary canal and the muscular coats of the stomach and bowels; between the mucous lining and the muscular coats of the bladder and the uterus; to which the voluntary force of the pectoral and abdominal muscles is added, when greater expulsive power is required. It is by this law of association that the circulation of the blood is likewise carried on. The stimulus of the blood acting on the sentient extremities of the nerves expanded on the lining membrane of the heart and arteries, causes the contraction of the muscular fibres; and thus sensation and motion alternating, maintain the current of blood from the heart to the most minute and remote capillary. In proof of this, may be cited the well-known fact, that an artery ceases to pulsate, or is reduced to the state of a passive tube, when it is dissected from its adjacent connexions—that is, when its nerves of sensation and motion are divided.

In like manner the respiratory motions are maintained. The air acts as a stimulus upon the sentient extremities of the nerves expanded on the bronchial membrane; by the law of association, the nerves distributed to the muscular fibres of the bronchial tubes excite muscular contraction, and thus the air received by inspiration circulates to and from the vesicles, again to be expelled by expiration. Thus the peristaltic motion of the alimentary canal is preserved. Of the universal prevalence of this law of association there can be no rational doubt. It serves to explain all the actions of the animal economy, which depend upon the reciprocal alternations of sensation and motion.

The term *sensation* is not limited to the cognizance which the mind takes of impressions made upon the sentient extremity of a nerve, but is extended to those impressions which are made upon its origin, whether cognizable by the mind or not. Impressions of the latter kind are made upon the sentient extremities of nerves which, by the law of association, maintain the vital and animal functions through the muscular or motor nerves. Of this kind are those contractions of paralytic limbs in which sensation is said to be destroyed. But so long as the integrity of the nerves from origin to termination remains, sensation and motion are preserved, although the person is unconscious of it, because of the lesion which the brain or spinal cord has suffered.

The *cui bono* of these observations is the practical inquiry to which they lead, as to the origin and treatment of abnormal actions. Inordinate contraction of the iris may arise without any affection of the retina; of the orbicularis, without any irritation of the conjunctiva; of the respiratory muscles, without any irritation of the bronchia; and violent expulsive efforts, without any irritation of the intestinal, vesical, or uterine mucous membrane. The distinction is of great importance in the treatment of the several morbid conditions to which these organs are liable, between those which originate in the sentient expansion and those which originate in the motor termination of the nerves.

Cough, originating in the motor filaments, which resists all the ordinary remedies, supposed to act specifically upon the bronchial membrane, yields at once to those remedies which are directed to the abnormal condition of the nervo-muscular apparatus of the chest. On the other hand, the inordinate action of the heart and the extreme rapidity of pulse, without febrile excitement, produced by certain acrid aliments and by some medicines, (iodine, for example,) is the effect of stimulating the sentient expansion of the nerves on the lining membrane of the heart and arteries, and occasioning, by the law of association, excitement in the nerves, terminating in their muscular fibres and consequent violent muscular contractions, for the purpose of expelling, *per vias naturales*, the offending cause from the blood.

Montague-street, Russell-square, May, 1845.

CHEMISTRY, PHARMACY, AND MATERIA MEDICA.

THE COMPOSITION OF TAURINE.

At a meeting of the French Academy of Sciences, May 5th, M. PELOUZE announced to the Academy, on the authority of Professor Liebig, a highly important fact relative to the composition of the animal secretions, especially that of bile.

One of Liebig's former pupils, now professor of chemistry at Vienna,—M. Redtenbacher,—having submitted *taurine* (asparatine biliate of M. Gmelin) to a new analysis, he found in that substance no less than 26 per cent. of sulphur. Taurine is one of the most brilliant products of organic chemistry, from the regularity of its crystalline forms.

Other chemists, who have examined the composition of taurine, have not recognised the presence of sulphur, but they have assigned to it the formula $C_4 H_7 N O_6$.—*Comptes Rendus*.

TESTS FOR CREOSOTE.

The creosote of commerce is very commonly a mixture of various hydrocarbons, eupione, &c., and containing variable proportions of true creosote.

The strength and medicinal efficacy of creosote depending mainly upon its purity, it is indispensable that purchasers should be able to apply an easy and satisfactory test. Dr. Ure, in the Supplement to his "Dictionary applied to the Arts and Manufactures," proposes to test the purity of creosote by its specific gravity, a method wholly inapplicable to the purpose, and devoid of any scientific basis. The following test may be relied on:—Place a drop upon the skin of the hand, allow it to remain for about one minute, and then wash it off with water; if the creosote is pure, it will act as a powerful escharotic, producing a white spot, which will shortly become red, with a pungent sense of burning. The intensity of its caustic effects, indeed, stands in direct ratio to its purity; many commercial specimens will be found to exert very little, or none. Moreover, pure creosote is perfectly soluble in caustic potass.

ON THE PURIFICATION OF HONEY. BY M. VELING.

The white of one egg is beaten up with five pounds of honey, till it froths; as much water is then added as is sufficient to form the consistence of a thinnish honey; it is then mixed, and boiled until the albumen can be removed with the froth; it is then poured into an upright vessel, two or three inches above the bottom of which a cock is inserted; it is well covered, and set aside in a cellar for six or eight weeks. The impurities, which otherwise stop up the filter, or the finer portions of which pass through, become coagulated in the vessel, and collect at the bottom and on the sides, and the honey can be drawn off clear by the cock.—*Archiv. der Pharm.*, xl. p. 155.

ON THE PREPARATION OF CHLORINE WATER.

MM. RIEGEL and WALTZ, in their experiments on the quantity of gas contained in chlorine water at different temperatures, have arrived at results exactly similar to those of Pelouze, except that they found the maximum somewhat greater than he did, (3 vols. at 50°.) They did not find Buchner's method preferable to that of the fifth edition of the Prussian Pharmacopœia. They also consider the preparation in the dark, and the preservation in bottles, with glass stoppers, as unnecessary. The water appears to be best preserved in small bottles with good corks, and covered with bladder. That which contains about two volumes and a half of chlorine, and preserved at 54° Fahr., appears to keep best. They recommend, therefore, that the chlorine evolved from twelve parts of well-dried chloride of sodium, nine parts of peroxide of manganese, ten parts of concentrated sulphuric acid, and ten water, be conducted into distilled water, which is retained at the temperature of 54° Fahr. until it is saturated. The chlorine contained in it is best tested, according to the authors, with a solution of pure indigo in sulphuric acid, which is so diluted as to contain $\frac{1}{184}$ th of indigo. Two parts of chlorine water, of the above strength, are exactly sufficient to decolorize one part of this solution of indigo. To detect muriatic acid, the authors recommend metallic mercury, and for chlorous acid the protochloride of mercury.—*Jahrb. für Prakt. Pharm.*, ix. p. 154.

ADULTERATION OF SAFFRON.

J. MULLER recommends concentrated sulphuric acid as the most certain test for saffron, for it immediately turns the colour of pure saffron to indigo blue, (it however soon changes to dark red and brown.) The leaves of *crocus vernus*, which form the most frequent adulteration, are coloured of a dark green by sulphuric acid.—*Archiv. der Pharm.*

Mr. C. Percivall, stationed with the artillery in Canada, states, that "out of sixty horses quartered at Montreal, thirty are affected with *bronchocele*, or "goitre," as it is called, without suffering, however, the slightest inconvenience from it. To what such general prevalence of this disease is attributable is unknown. It is ascribed, generally, to the snow, and iced water.