THE PERMEATION OF ORGANIC AND OTHER FLUIDS.

It is well know that at various stages of the functions of different organs there is a direct passage of liquor from one portion to another of the organs. Thus, for example, from the stomach and bowels at certain periods there is a permeation of liquor, consisting of the soft and dense fluid products of digestion, through the side of the intestinal canal, into the blood and lymph vessels, which ramify in the thickness of its walls. So too, also, there is during certain periods a transit of fluid from the blood vessels, ramifying through certain glands (for example, the salivary) into the ducts of the mouth. Phenomena of this character have been long mistakenly likened to those which were transacted between different fluids partitioned outside of the animal organisms. The whole two series together have been comprised as endosmosis and exosmosis.

If a glass vessel have a thin, upright partition of plaster of Paris through its center, and on the right hand side brine be placed, and on the left pure water be poured, until the divided fluids are at one level, a flow is immediately established through the partition, and the brine will soon rise, while the clear water will lower in exact proportion. This is endosmose. The mixture of the two fluids, if the partition were removed, would be easily understood as one of the simplest of mere physical phenomena, and the only action of the partition is to graduate the rate of the flow, and thus allow the phenomena to be observed.

This is strictly true with substances having such large pores as plaster; but when an inanimate membrane is used the tissue of it seems to exert a more definite action. The change in volume of the side by side fluids depends on the difference of their properties. In mixable liquids this is determined by their capacity for water, and acts the same between solutions of different density of the same substance. as between different substances. Solutions in water, of gum, gelatin, etc., increase in volume when opposed to water.

Each kind of matter has a tendency to diffuse itself through the pores or interstices of every other kind. And this tendency explains the solution of bodies. The various degrees in which this exists in different bodies accounts in part for many of the at first mysterious phenomena of physiology.

When a body is plunged into water it is either wetted or the reverse, according to its capacity for that fluid. If wetted, then its pores are saturated with moisture. This phenomenon is very simple, yet it is perfectly analogous to fundamental phenomena in the realm of physiology. This wetting is the first result of adhesion, or the first intimation of chemical affinity. That it is a result of chemical or physical affinity is shown by the fact that different substances act with different power. Thus while water will readily flow into the pores of chalk, mercury will not enter there at all, but is rather repelled. But while metals are really impervious to water, mercury will interpenetrate them.

Solids indicate various degrees of penetrability for water. A tube filled with glass, powdered very fine, will elevate water 170 millimeters, when the lower extremity is immersed in that fluid, while a tube containing glass, coarsely powdered, elevates it only 107 millimeters. This depends on the minuteness of the pores, by which a greater surface, and consequently a fuller action, is exhibited. It is evident that when the pores are large, the atoms of water occupying the central portion, do not come in contact with so large an extent of surface, and hence are not influenced.

This surface action of the pores is well shown by the filtration of liquids. Salt water passing through a column of sand becomes fresh, but if the current be continued, it at length flows through unchanged; for after the surfaces of the sand grains have attracted all the salt they can hold, they permit the remainder to pass unimpeded.

The exact reverse of this is obtained with some solutions, as carbonate of soda; the sand having a stronger affinity for the water than for that substance, the fluid flows out more concentrated than it enters.

The principle of the elevation of a fluid by a column of sand or powdered glass is the same as that of a capillary tube. The minute spaces or pores between the grains form a continuous, if tortuous tube, throughout their whole extent, up which the fluid is drawn. The hight to which it will ascend is limited by the size of the pores, as in a continuous hollow tube. The fluid will not aggregate and flow from the surface, for the reason that they are thus drawn up and held by the attraction of the interior of the pore or tube.

The central portion is never so much elevated. The pressure of the atmosphere accelerates, but does not otherwise affect the ultimate hight to which the column of fluid will ascend. The effect is the same in vacuo; nor does the hygrometric state of the atmosphere vary the result.

Elevation of temperature increases the hight to which a fluid will ascend, and also the rapidity. Heat increases the energy of affinity. Warm liquids are more readily absorbed than cold.

When a colored solution is dropped on a piece of chalk the water penetrates into the pores of the chalk, leaving the coloring matter on the surface; and this is not because the particles of the coloring matter are too large to enter the chalk. If fluid mercury be dropped upon the chalk it will not be absorbed—it will not wet it; in other words, there is no affinity between the atoms of chalk and mercury. The phenomena here are the same as in capillary attraction; unless the fluid is capable of wetting the tube it will not be affected. Porous bodies, like tubes, imbibe fluids for which their atoms have attractions, and repel those for which they have not.

If an end of an open glass tube of small size be placed in water, that fluid will rise to a considerable hight; but if the tube be placed in the mercury it will fail to enter, and will be depressed below its external level. Not only are fluids and gases absorbed by porous bodies, but they are peculiarly affected in the act. When the pores are extremely minute, they exert a decided condensing influence, especially on gases. Spongy platinum, placed in a jar of hydrogen and oxygen, becomes bedewed with water produced by liquefying of these gases, *i, e.*, their union. Spongy platinum condenses 252 times its own volume of oxygen, and then has become a powerful oxidizing substance. Prepared charcoal exerts so strong an attraction that it completely removes the nitric oxides from solutions of lead, tartar emetic, ammoniated oxide of copper, chloride of tin and zinc. Charcoal will absorb the coloring of almost all organic substances.

All bodies, even the densest minerals and metals, are permeable to fluids and gases. Water may be used as a partition between gases, and is found to be one of the most permeable of substances. The water of lake and river contains common air, but this air contains one fifth oxygen; that of the atmosphere contains about one third. It is from this richness of oxygen that aquatic organisms derive their support.

Solution is an imperfect form or stage of chemical affinity, in which change of form occurs without change of properties. If water be added to an alcoholic solution of camphor, the latter is at once precipitated, for the alcohol has a greater affinity for the water than the camphor, and when a solution of salt in water is treated with alcohol, the salt at once crystallizes at the bottom of the vessel, thus showing that both were held in solution by chemical affinity.

The line of distinction between capillary attraction and chemical affinity is indefinite. Hence Clairaut's formula, "if the attraction of the particles of a solid for those of a fluid is more than half the attraction of these last for each other, the solid will be wetted; but if it be less than half, the solid will not be wetted."

Capillary attraction is not only related to chemical affinity, but also to attraction of cohesion. When two pieces of lead, on being pressed surface to surface, adhere; when two plates of glass become attached, or when a plate of glass adheres to the surface of water, one and the same principle is involved. But in the passage of animal fluids through membranous tissue, it must not be inferred that the latter exert no power. On the contrary, they act on animal substances in a flowing state, with the most varied results.

The processes of absorption, secretion, and excretion, while they are illustrated by the physical processes we have described, to which they are strictly analogous, and while they moreover involve physical laws, exhibit a character which precludes our considering them physical, and which distinctly distinguishes them from, and elevates them above chemical proceedings.

Such is the history of the phenomena of endosmosis. They are a series which are not physiological, but which are dependent on physical laws and the physical properties and relations of substances. They bear no nearer relation to the phenomena of physiological transudation than the descending flight of a swallow or an albatross does to gravitation. Undoubtedly, both alike involve the existence of physical substances and properties, since, if the body of the bird had no weight, it could not descend; and so also the liquids and secretions of the body could not permeate vessels unless the fluids had physical properties. But these properties are not what constitute the heart of the phenomena, nor can they be alleged to explain them. The physical side of the phenomena are made strictly subservient to other and higher processes than they are capable of. The essential conditions of absorption in animate organisms are a cell wall, whose composition is in great part water, and a fluid of animal substance. The products of digestion are animal substances in a flowing state, the composition of which, as food, was in large proportion water. This will pass through cell walls, or their interstices, not in virtue of the existence of defined passages or pores, but by displacing inwardly the particles of fluid already constituting a considerable part of the soft solid matter of the cell. Organic absorption commences and takes place in unison with prevailing organic actions. These are, the flow or progressive motion of the contents of the vessels that tend to draw into their own undisturbed current, soluble particles through extremely attenuate films of substance, interposed between fluid and current. Such films are cell walls. This is demonstrated by the fact that the power of different organs for absorption, depends on the number of vessels with which they are supplied, and the rapidity of the flow of their contents. This absorption, as in the case of the incoming of the products of digestion or soluble portion of food, is strictly organic, and is not to be induced under merely physical conditions; that is, where organic motions have come to an end, or where the tissues are exanimate. The readiness with which the fluid or watery portion of the contents of the blood vessels will leave them and infiltrate the tissues when the organism is really exanimate, attests the existence of condition during animation which held those fluids in their regular channel. The physiological refuses to be merged or swamped in the physical and chemical, while making both the latter subservient and ancillary to its own issues The more we study the phenomena of each department, the more complete and inflexible becomes our assurance that the two latter phenomena are not convertible with the physiological. In view of a proper estimation of the facts, the ordinary and uniformly accredited designation of the ingress of oxygen into the capillaries of the lungs, and the egress of their carbonic acid into the air-vesicles, as a phenomenon of the diffusion of gases, seems far from the truth.—*Dental Cosmos.*

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PRACTICE and persistence are the elements of the mechanic's success.

For the Scientific American.

METRIC SYSTEM.

In the year 806, in the first days of the month of May, near Aix-la-Chapelle, in the middle of a plain shaded by young poplars recently imported from Italy, numerous workmen were engaged in embellishing a magnificent tent of circular form, and being not less than one hundred and fifty cubits in diameter. Rich silken flags, representing the different countries conquered by Charlemagne, were hanging from each of the posts supporting the magnificent Turkish carpets which formed this elegant structure.

This tent was already filled with knights and deputies from all nations. Charles, on this occasion, intended to divide his empire among his three sons, Charles, Pepin, and Louis.

When the Emporor had arrived, seated on his throne, surrounded by his family and the principal officers of his kingdom, he rose, his aspect was imposing, his countenance thoughtful, open, but severe, recalling his German origin. He then spoke, and his words were repeated by interpreters standing in the middle of the representatives of each nation. After his speech, which was but an account, or rather a history of the first years of his reign, he caused his sons to be recognized as his successors, and having finished what he had to say respecting the settlement of public affairs, he turned toward his secretary, Eginard, saying: "It is your turn, my friend; speak to the learned men who are here present, and ask them for me if they have resolved the question I proposed to them last year."

This question was a very important and a very difficult one to solve. It was to find an imperishable unit of length. Charlemagne had already remarked that the ancient slade and cubit had no exactness.

The idea of giving to the nations of the earth a common measure, capable of being transmitted with exactness to the most remote posterity, was truly worthy of his genius.

Then, after Eginard had asked an answer from the learned men, a long silence prevailed in the assembly, notwithstanding the royal reward which the secretary had ready for the distinguished man who should find this wonderful unit. It was not timidity that kept those men silent, it was simply incapacity.

Understanding at last that this question was, if not insoluble, at least beyond the knowledge of his time, Charlemagne, after a moment of anger, stretched out his foot on the table before him, and ordered Eginard to measure it, which he did, including the shoe of polished steel worn at that time. This length named the king's foot was correctly marked inside of public monuments.

Charlemagne wished also that after his death his body and his shoes should be kept with care in a leaden coffin. "I do not think, said he, that after my death there will be a man so devoid of sense as to destroy or alter my mortal remains." In fact, no living being ever touched this celebrated foot, for even in 1793, when the French revolutionists in their fury sacked all the royal tombs, the king's foot was yet an object of veneration for the infuriated mob, and the leaden coffin was opened with great care. Alas! Time, not with his scythe, but with the help of his exterminating agents, the oxides, had destroyed not only the shoes, but even the bones of the monarch, and all was reduced to dust.

After the division of the kingdom of Charlemagne, the different States remained separated, and little by little the models of the king's foot have been lengthened by some and shortened by others, so that the true foot is lost.

If we take the English foot, or that of the United States, as a point of comparison, we find that the French foot is longer, and that of Spain shorter, and, indeed, we have as many king's feet as we have kingdom's in Europe.

In 1791, that is, 985 years later, the learned men of modern times thought of measuring the circumference of the earth in several countries. This difficult undertaking, the object of which was not only to ascertain the dimensions, but also the exact form of our globe was perfectly executed, and they took for unit of length the *meter* which is the ten-millionth part of the distance from the pole to the equator.

This meter, which can no more be lost than the earth which we inhabit, is equivalent in English feet to 0.3048 meter, and reciprocally a meter is equal to 3.28 feet, or 3 feet, 3¼ inches.

This meter determines the dimensions of the other units, which have new denominations and of which here is the table:

Are, unit of surface for land, is a square whose side is ten meters.

Liter, unit of capacity for liquids, is a cube whose side is the tenth part of the meter.

Stere, unit of solidity for wood, is simply a cube meter.

Gramme, unit of weight, imagine a small cube of water whose side would be the hundredth part of a meter.

Franc, unit of money, is a piece composed of nine parts of pure silver and one of copper, the weight of which is five grammes.

Thus all the units of weights and measures are derived from the meter which is the standard of this system.

To be able to form an exact idea of the absolute value of these new measures, we will compare them with measures that are familiar, thus: Meter, 3 feet, 3¼ inches; Kilogramme, about 2 lbs., 3 oz.; Liter, about 1½ pint.

Let us finish this article by an experiment which may be useful. We will add that if to a pin, A, we suspend a small ball, B, and that by shortening or lengthening the thread we succeed in making it oscillate sixty times in one minute, then the length of the thread from the pin to the center of the ball will be exactly 0.997 meter—very nearly one meter in the latitude of New York.

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