

In conclusion, I have only to remark that most commonly one particular nerve-fibre runs into each Vateria body. In one instance, further, I observed that one simple nerve-fibre is divided, and each portion terminated separately in one corpuscle.

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ART. VIII.—*Researches on the Acidity and Alkalinity of Certain Liquids of the Human Body, in the state of Health and Disease.* By M. ANDRAL. (*Annales de Chimie et de Physique. Troisieme Serie. Tome Vingt Quatrieme. Paris, 1848. P. 116.*)

THE different animal fluids considered in their physiological state, all present a certain degree of acidity or alkalinity. Some transitory influences may accidentally render them neutral. Thus the introduction into the stomach of a large quantity of water may in a rapid manner deprive the urine of its acidity. Thus also, when the skin is covered with a very abundant perspiration, this fluid, which is naturally acid, may cease to be so, and may present itself in the neutral form. But it is manifest that in each case the acidity of these fluids disappears only because their acid principle is accidentally diluted in a large quantity of watery vehicle.

In the physiological state no spontaneous modification of the organism is permitted to convert a liquid naturally acid into an alkaline liquid, and the converse. If this transformation is occasionally observed, this depends, as the transition to the neutral state, on influences foreign to the organism. Such in certain circumstances is the operation, either of articles of food or drink, on the decomposition of certain liquids, either in the air or in their reservoirs.

It may then be established as a principle, that in man, when in the state of health, whatever be the varieties of his physiological condition, each of the different liquids of the body preserves uniformly the same reaction, alkaline for some, acid for others; at most they may sometimes become accidentally neutral, when a large quantity of water is introduced into the blood, or when, with the occurrence of the circumstance now mentioned, the liquids are secreted in much greater abundance than usual. This is particularly remarkable as to the case of cutaneous perspiration; which shows that, when the latter is increased to such a degree as takes place during sweating, the augmentation of the cutaneous perspiration has the effect of removing from the blood proportionally a greater amount of water than of other principles; for, if this did not take place, and notwithstanding its increase in quantity, the matter of the cutaneous perspiration would remain at all times acid.

When man is attacked by disease, the question is naturally suggested, do the fluids preserve the same sort of reaction as in the physiological state? can those fluids which are in the state of health alkaline, become acid in consequence of disease, and reciprocally? This question must be placed among those to which a definitive answer has not yet been given. It has been often repeated, and it is an opinion generally entertained, that to a certain number of diseases is given the power of modifying the fluids to that degree, that those which are naturally acid become alkaline, or those which are alkaline become acid. This opinion, brought forward at different periods of science, has been employed to support more than one theory upon the proximate cause and the nature of diseases; it has led to the establishment of symptoms to recognise the presence of certain diseases, and it has been employed to deliver several therapeutic precepts. It therefore appears to me not without importance to subject to the inquiry a new examination, and to learn if, in diseases, and by their influence, the two reactions, acid and alkaline, of the human fluids, are susceptible of being modified by being converted into each other.

Of all the liquids in the economy, the serum of the blood is that which has always appeared to me to present the strongest alkaline reaction. The intensity of this action appears not to vary sensibly, whatever be the nature and the duration of the disease.

It has been said that, in the instances in which the blood became very poor in fibrin, the proportion of its alkaline principles was increased; but the facts adduced in support of this opinion are as yet too few to permit us to ascribe to them great value. It has been said also, that in saccharine or true diabetes the alkaline element of the blood was diminished; but, to my knowledge, no analysis has been cited in support of this important statement.

May it happen in certain instances, that the blood loses its alkaline reaction? This question I propose, because a respectable author, Vogel, in his *Pathological Anatomy*, has recorded on the authority of Scherer, the case of a woman labouring under metro-peritonitis, in whom Scherer states that he found perfectly neutral the blood which had been drawn from the vein in blood-letting. Vogel, who relates this fact without denying it, and even without discussing it, remarks, nevertheless, that he has never observed anything similar. For my part, I have to say that the alkaline condition of the blood is in my eyes a general law, to which hitherto I have found no exception. As to the instances of which Vogel has in like manner spoken, and in which the blood was found acid, I cannot admit their validity. He proceeds, in his further discussion of the subject, without saying that my negation applies only to cases in which the blood examined was that of living individuals. Vogel, indeed, affirms that he has

sometimes found the blood acid after death; but this acidity was then the effect of decomposition which the blood had undergone; it was no longer a fact of disease.

The liquids which are formed from the blood are seldom found in the neutral state. Most commonly, either they continue alkaline, like the blood from which they proceed; or they present an acid reaction more or less decided. This is what takes place in the physiological state. I now proceed to inquire what change the interposition and presence of disease may communicate in this respect to these fluids.

Previously, however, it is necessary to establish one fact. This is, that at the most of the surfaces of the body, external and internal, there are arriving at one and the same time several liquids, which most frequently present different reactions; so that, if the inquirer be apprised of this circumstance, he might commit a mistake by ascribing to a change in reaction in one of these liquids that which depends solely on the accidental predominance of the other.

For instance, the skin secretes two materials with different reactions; one is acid,—it is the perspiration; the other is alkaline,—it is the sebaceous matter.

Whatever be the conditions of health or disease, in which I have examined the perspiration, I have found it most commonly acid, sometimes neutral, never alkaline.

I have specified above in what conditions I have established the neutral nature of the perspiration. It is when it is extremely abundant. No disease removes its acidity; by no disease is it rendered alkaline. In typhous fevers, however severe they may be, the acidity of the perspiration continues. Nor is it true that this quality disappears in true diabetes, a disease in which, further, there are more frequent opportunities than is usually supposed, of being convinced of the properties of the perspiration; for in diabetic patients the cutaneous perspiration is often augmented; and I have seen diabetic patients, who, when arrived at a very advanced stage of the disease, presented, either in the course of the day or during the night, very abundant sweatings, though they were not labouring under pulmonary tubercles.

The skin, nevertheless, does not everywhere present an acid reaction; and in several points, even where it is covered with perspiration, it may exhibit a reaction perfectly alkaline. These points are those in which are numerous sebaceous follicles; for instance, on the nose in some persons, and more generally in the hollow of the arm-pits, over the eyebrows, and in various other parts provided with hairs. It is certainly not the perspiration which in these parts requires peculiar properties; that is not the secretion which becomes alkaline. It is the fat matter contained in the follicles which, in parts of the skin in which it is abundant,

produces this reaction. This phenomenon, nevertheless, is not constant. While it is very well marked in certain individuals, it is not observed in others; and, further, it is present or absent independently of every special condition of health or disease.

Perspiration, then, is not simply the water of the blood which has escaped through the skin loaded with a greater or less amount of the principles of the serum. If such were the nature of the perspiration, then it ought to be alkaline, as is the serum of the blood, and as are the greater number of the liquids which are separated from the blood at the surface of the skin. Thus the liquid furnished by a portion of the skin, which has been irritated either by a burn or by the application of a common blister, or that produced by strong hartshorn, always presents a marked alkaline character. The fluid contained in the vesicles of herpes, or of ekzema, or in the blebs of pemphigus, is in like manner always alkaline. In all these instances, in which a process of congestion more or less intense precedes the exudation, it must be admitted that it is the serum of the blood which, modified only as to the respective proportion of these elements, is expelled from the vessels, and is effused on the free (epidermal) surface of the skin. There is, nevertheless, one vesicular eruption which is distinguished from all others by this circumstance, that the appearance of the vesicles is preceded by no symptom of congestion, and that it is the first and the only appreciable pathological element. This is the eruption known by the name of *sudamina*, a species of miliary eruption. By a remarkable exception, the liquid of the *sudamina* differs from that of all the other vesicular affections of the skin in this circumstance, that, instead of being alkaline, it is, on the contrary, remarkably acid; and in it we find no trace of albumen, while this principle is met with in all the others. The fluid of the *sudamina* is, therefore, the product of a peculiar process quite different from that which causes the other vesicular eruptions. This liquid, in its acid reaction, and its want of albumen, entirely resembles sweat. Often also, in the state of disease, we see *sudamina* produced in individuals who have very profuse sweats; but this last circumstance is not the sole cause of the occurrence of this form of eruption; for, in many instances of typhoid fevers, we observe multiplied *sudamina* covering the skin of the trunk, of the neck, and of the extremities, without sweating perceptibly taking place.

On the mucous membranes, in a degree still greater than on the skin, we find almost in all instances at the same time liquids of different kinds, and usually of different chemical reaction. Hence arises a certain difficulty in discerning, amidst this association of liquids, the reaction which belongs to each; hence, also,

proceed the chances of error which have not in all cases been avoided.

In all parts of their extent, the mucous membranes in their healthy state furnish like the skin an acid principle. This principle exists in the transparent and globule-less fluid which these membranes separate from the blood in their physiological condition. But if, as is frequently the case, there be substituted in the place of this liquid an opaque matter with globules, the acid reaction disappears, and its place is supplied by a well-marked alkaline reaction. Thus we find uniformly alkaline the opaque mucus which is so readily secreted by the mucous membranes, as soon as they have become the seat of an acute or chronic inflammatory process. Few liquids, for example, are so strongly alkaline as is the puriform mucus furnished by the nasal cavities in cases of coryza. In bronchitic attacks, the matter expectorated presents sufficiently often united the two species of reaction, acid and alkaline; the portions of this matter which remain transparent are acid; those which have become opaque are alkaline; and those two reactions are observed to remain perfectly distinct beside each other.

The mucous membrane of the mouth, including that which covers the two surfaces of the tongue, presents a reaction, which is not at all times the same. If examined in the morning, before any food has been taken, it presents in the great majority of cases an acid reaction; but in the course of the day this condition changes, and becomes alkaline. The first sort of reaction belongs to the matter furnished by the buccal mucous membrane; the second belongs to the saliva. It is, therefore, a mistake to say that the acidity of the mouth is owing to a morbid state of the stomach, and particularly that it denotes the presence of inflammation of the stomach. Acidity of the mouth is not a pathological fact. It is observed in persons in the best possible health, in those who digest in the most healthy manner, and it may be found in the most opposite diseases. It disappears as soon as a certain quantity of saliva is caused to flow into the mouth; it is observed to be much more strongly marked, in proportion as the period at which it is examined is longer after that at which food has been taken; and hence it is easy to understand how this reaction is stronger and more enduring in diseases, in which for a certain time a system of strict diet has been observed.

Thus, therefore, the liquid which is separated from the mucous membrane of the mouth, is, in the physiological state, acid; and such it remains, in all possible forms of the pathological state. In those instances in which the mouth shows itself to be alkaline or neutral, that is not because this liquid has changed its nature. It is because its secretion has ceased, or because its chemical re-

action is disguised by that of another liquid, which derives its origin not from the mucous membrane.

When, after death, a slip of turnsol paper is applied over the mucous membrane of the mouth, most commonly we observe that this paper is very decidedly reddened; sometimes it remains blue; but never has the gastric mucous membrane presented to me any alkaline reaction. As to the acid reaction of the stomach, I have observed it, both in the instances in which the stomach contained the remains of food, and in those instances in which for a long time no digestion could have taken place. By what means are we to reconcile these facts with others furnished by experimental physiology, and the result of which is to show, that the stomach would evince acid reaction only when stimulated by the presence of food or of different foreign bodies, while, when it is empty, it presents no alkaline reaction whatever? This is not what I have found to be the case in the human body. The various morbid states, in the midst of which patients are overtaken by death, have not appeared to me to induce any modifications in the nature of the reaction of the stomach. I have found it acid in the most different disorders; in typhus fever, in acute inflammations of the lung, in pulmonary consumption, in albuminuria, in true diabetes. This same acid reaction is further found, in a manner very nearly uniform, in the matters rejected from the stomach in the act of vomiting. There are among others few substances, which communicate to turnsol paper so decided a red colour as the black matter formed by the blood, which is so often vomited by patients labouring under a cancerous affection of the stomach.

Further, it is sufficiently common to find in the human subject after death, an acid reaction in the mucous membrane of the duodenum and in that of the jejunum. Nevertheless, as in this portion of the alimentary canal, there are received from the liver and the pancreas, fluids of alkaline characters; it is not very uncommon to observe this species of reaction in the duodenum, and even below that bowel. In the large intestine, I have in all instances ascertained a well-marked alkaline reaction.

I have yet to examine the nature of the reaction presented by the fluids secreted by several of the glands.

The tears have appeared to me to be uniformly alkaline. The same is true of the saliva. It has been stated, that in certain conditions of disease the saliva might lose the alkaline element, which constitutes its normal character, and might become acid. I think myself entitled to conclude, from my researches on this subject, that this result never takes place, and that to no disease is given the power of converting the saliva into an acid liquid. I have already said that in many persons, whether in health or under disease, the mouth presents a most decided acid reaction. This species of reaction has been erroneously ascribed to the saliva. It is easy

to prove that this acid reaction is not the effect of the saliva, by introducing into the mouth any sapid body; under the influence of such body a quantity of saliva flows rapidly into the mouth, and from that moment we find in the cavity of the mouth a well-marked alkaline reaction. This fact shows that in this instance it is not the saliva which is acid; it is the liquid which is furnished by the mucous membrane of the mouth. It is, therefore, manifestly a mistake to assert, that in inflammations of the stomach the saliva becomes acid. An error is in like manner committed, when it is asserted that in diabetic patients the saliva acquires acid properties. Often, unquestionably, in diabetic patients, we find in the whole mouth an acid reaction; but this phenomenon is not peculiar to diabetes; and no more in this disease than in others does the acid reaction depend on the saliva. In order to be certainly convinced of this fact, I have caused diabetic patients who presented this reaction to chew a little of the root of pellitory; by this means I have produced, in a few instances, an abundant flow of saliva; and I have found, without doubt, that this liquid preserved its ordinary alkaline character. Thus falls to the ground one of the principal arguments which speculators have employed in order to support the hypothesis, according to which the formation glycosuria is regarded as the product of the acidification, either of the blood, or of other fluids of the animal economy.

In the state of health, the urine, when it has not remained too long in the bladder, and if it be examined shortly after it is voided, is always acid. This acidity, however, may become very feeble, or even may disappear, and be succeeded by a neutral state, if a very large quantity of drink has been introduced into the stomach, and if at the same time a copious diaphoresis do not take place. Under the influence of this latter process, the acidity of the urine is increased in a remarkable manner.

Some accidental circumstances may, in a person in good health, render the urine, for the moment, alkaline. Thus it may become alkaline in consequence of the introduction of water, loaded with alkaline salts, into the stomach; it may acquire alkaline properties during the use, more or less lengthened, of a diet exclusively vegetable. The privation of food, however long continued, does not deprive the urine of man of its acidity. But a remarkable circumstance is, that we see in some convalescents the urine become transitorily alkaline, at the time when we begin to allow them to take food.

In diseases, the numerous modifications which the urine undergoes in its composition, do not deprive it of its acidity; and if it loses this character, it is in consequence of influences of a character quite special, which I shall immediately explain. How multiplied soever have been my observations on this point, I have yet to find an instance in which, by the influence of disease

alone, the urine passes from the kidneys in the state of an alkaline fluid. To me it is evident, that there is an error in the observations of those persons who have stated, that in typhoid fever the urine becomes alkaline. Already has this assertion been controverted by M. Rayer; and in his work on Diseases of the Kidneys we find it stated, "that having investigated the nature of the reaction of the urine in fifty cases of typhoid fever, not one was found, in which it had become alkaline." My own researches have led to the same result. Whatever be the form which the disease has assumed, however intense might be its severity, and even in its most advanced adynamic period, I have at all times found the urine decidedly acid. In those cases even in which the urine had remained a long time in the bladder, and in which the urine examined by me had been withdrawn by the catheter, it retained most usually its acidity. The opinion that in severe fevers the urine becomes alkaline, appears to me rather to have been delivered under the influence of certain hypothetical ideas than from any attentive observation of facts.

We read in several authors, that the diseases of the spinal chord possess the power of modifying the secretion of the kidneys in such a manner as to render the urine alkaline. In this respect these authors have manifestly confounded two different things. When in a person labouring under a disease of the rachidial marrow, the bladder remains sound, the urine which it contains enters it in an acid state, and is discharged from it in like manner acid. But if, on the contrary, the mucous membrane of the bladder has become the seat of a purulent secretion, the urine then is changed within this receptacle, and there becomes alkaline. This phenomenon, however, takes place sufficiently often in proportion to the frequency of affections of the bladder, at a period more or less advanced of diseases of the spinal marrow. The affections of the bladder are, in truth, the only morbid condition which I have seen render the urine alkaline; not that, however, which proceeds from the kidneys, but that which is contained within the bladder. The change which the urine then undergoes is a phenomenon entirely chemical. Placed in contact with purulent matter or other morbid products furnished by the bladder, the urine is decomposed and becomes ammoniacal. Further, purulent matter itself, whatever be its source, is a fluid in all instances alkaline; we find it acid only in some instances in which it has become changed in consequence of prolonged exposure to the air. The constancy of the alkaline character of purulent matter is, further, a consequence of its nature. What is purulent matter in truth except serum of the blood, in the midst of which are spontaneously developed special globules? Purulent matter, therefore, must in all cases be alka-



line at the moment of its formation, as are always both blood and the different morbid serous fluids.

Thus, therefore, the different fluids of the animal economy exhibit, in the nature of their reaction, whether it be acid or alkaline, a degree of uniformity infinitely greater than might have been imagined. Amidst the varied modifications which the state of disease communicates to the composition of these fluids, disease possesses not the power of changing their mode of reaction, and in all instances they proceed with like properties in this respect, from the apparatus which separates them from the blood. The unchangeable character of the secretion of the alkaline and acid principles of the animal fluids is therefore a law of the physiological state, as well as of the pathological state; and the preservation of this law must be very important, since it continues, without exception, modified only in the case of the urine, in a temporary manner, by certain influences depending on dietetic conditions.

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ART. IX.—*An Experimental Inquiry into the Effects of Hydrocyanic Acid, produced upon Animal Life.* By THOMAS NUNNELEY, Esq., F. R. C. S. E., Surgeon to the Leeds Eye and Ear Infirmary, and Lecturer on Anatomy in the Leeds School of Medicine. (Transactions of the Provincial Medical and Surgical Association. New Series. Vol. iii. 1847). Abstract.

THE deadly effects and the rapid operation of hydrocyanic acid upon animal life have been long known to the profession. Its employment in the treatment of various painful and unmanageable diseases,—namely, pulmonary consumption, certain diseases of the heart, certain affections of the stomach, some nervous affections, and some varieties of neuralgia,—have all contributed to render the knowledge of its powers generally known to the public. The occurrence also of various fatal accidents in instances in which it was administered by the direction of physicians have tended to the same results, and have made it be justly regarded as an agent of great power over the vital functions. The energy with which it acts, has recommended it for purposes both of murder and suicide; and, while in not a few instances fatal effects have taken place under professional or pretended professional administration; peculiar circumstances have tended to invest with obscurity the question of the mode in which it operates, and whether it is possible in all cases to distinguish its effects, either in the mode in which death takes place, or in the appearances afterwards found in the dead body. In short, though it is generally known that hydrocyanic acid is a most energetic agent,