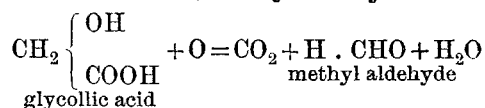


I have endeavoured to show that in acute rheumatism, by the separation of the cyanalcohols $\text{CH}_2 \begin{Bmatrix} \text{OH} \\ \text{CN} \end{Bmatrix}$ and $\text{C}_2\text{H}_4 \begin{Bmatrix} \text{OH} \\ \text{CN} \end{Bmatrix}$ from the rest of the albuminous chain, we have glycollic and glycollic and lactic acids formed, the glycollic acid being oxidised into CO_2 and water, the lactic acid in some measure being oxidised into these products, and in some measure passing off by the skin. But suppose that whilst the vaso-motor fibres of the muscular nerve are paralysed and the vessels dilated, the molecules $\text{CH}_2 \begin{Bmatrix} \text{OH} \\ \text{CN} \end{Bmatrix}$ are detached and hydrated into glycollic acid, but only partially oxidised, the result would be that the glycollic acid would be transformed into carbonic acid, methyl aldehyde and water:



Condensation of six molecules of the aldehyde may then take place, as in plants, forming glucose:

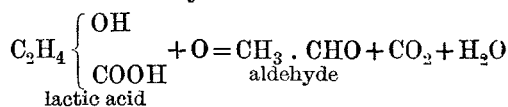


By urari, as I have already stated, we can put a stop to muscular contraction, that is, to the oxidation of the muscular elements and to the formation of CO_2 when the muscular nerve is stimulated. If, then, the tissue be, so to speak, partially urarised, the aldehyde is not oxidised, but condenses into glucose. In urari-poisoning sugar appears in the urine, though "the exact way in which this form of diabetes is brought about has not yet been clearly made out."²²

Let me carry you one step further in the comparison between rheumatic fever and diabetes. If in rheumatic fever the central part of the nervous system connected with the muscular nerves is so enfeebled that there is complete dilatation of the vessels in the muscular area, and a falling asunder not only of the molecules $\text{CH}_2 \begin{Bmatrix} \text{OH} \\ \text{CN} \end{Bmatrix}$, but also of

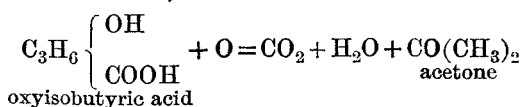
the molecules $\text{C}_2\text{H}_4 \begin{Bmatrix} \text{OH} \\ \text{CN} \end{Bmatrix}$ and $\text{C}_3\text{H}_6 \begin{Bmatrix} \text{OH} \\ \text{CN} \end{Bmatrix}$ then by the hydration and oxidation of these, hyperpyrexia would in some measure, as I have suggested, be developed. But if the complete oxidation of these molecules were interfered with, the $\text{CH}_2 \begin{Bmatrix} \text{OH} \\ \text{CN} \end{Bmatrix}$ would give rise in the manner above

indicated to glucose. By hydration $\text{C}_2\text{H}_4 \begin{Bmatrix} \text{OH} \\ \text{CN} \end{Bmatrix}$ would be converted into lactic acid, which, if not completely oxidised into carbonic acid and water, would be first oxidised into carbonic acid and aldehyde:



the aldehyde by condensation forming para-aldehyde, a remedy recently introduced as a hypnotic. Hence the drowsiness which shows itself in some stages of diabetes.

If the molecules fall still more completely asunder and the molecule $\text{C}_3\text{H}_6 \begin{Bmatrix} \text{OH} \\ \text{CN} \end{Bmatrix}$ become detached and hydrated into oxybutyric acid, but only partially oxidised, then from one form of this acid, acetone would be formed:



which appears in the urine towards the termination of the disease. So, then, in hyperpyrexia there is detachment of the molecules from the benzene nucleus, with their hydration and rapid oxidation; whereas in acetonæmia there are detachment and hydration, but imperfect oxidation of the molecules. That is to say (if this theory is correct, and such experiments were possible), by urarising an individual suffering from rheumatism with pyrexia the urine would become saccharine; if hyperpyrexia were present, by urari the disorder would be transformed into acetonæmia.

Now you will find that in some forms of diabetes salicylic acid is of the greatest service, whereas in others no good results from its use. Given in doses of from ten to twenty grains three times a day, I have frequently seen it produce

marked improvement, and Dr. Holden, of Sudbury, has shown me notes of cases, about to be published, where rapid amelioration of the symptoms has resulted from its use.

The urine in these cases contains often, in addition to glucose, an excess of uric acid, and the patients suffer from neuralgic pains in the joints and limbs. It also not infrequently contains some substance which dissolves cuprous oxide, and so more or less interferes with the application of Fehling's test. What this is has not yet been determined. My friend, Mr. Pattison Muir, kindly examined some specimens, and made out that it is some substance which readily dissolves calcic phosphate. Possibly it may be glycollic or lactic acid. If further examination should prove this to be the case, it would go a long way to support my view of the origin of this form of diabetes.

I have thus endeavoured to indicate some of the changes in the nervous system, the blood, and the tissues which may take place in diabetes, rheumatism, and gout, and to enlarge upon the text furnished by a far-seeing pathologist,²³ when he wrote: "Disturbance in the nervous system in some form and part may be regarded as a factor in every case of gout. There are reasons enough for thinking that changes in the nervous centre determine the locality of each gouty process, while changes in the blood and tissues determine its method and effects; and that thus we may explain the symmetries of disease in gout—sometimes bilateral, sometimes antero-posterior,—and thus its metastases."

My task is done. It only remains for me to thank you, Mr. President and the Censors, for giving me an opportunity of placing my views before the College, and to the distinguished Fellows and Members who have listened to me. I have brought together a number of facts, and endeavoured to draw certain inferences from them. The inferences may be wrong, but the facts remain; and I trust that in this way, at least, I may have helped to a better understanding of these disorders.

ABSTRACTS OF THE

Lumleian Lectures

ON THE

ELECTRICAL CONDITIONS OF THE HUMAN BODY.

By WILLIAM H. STONE, M.A., F.R.C.P.

LECTURE II.

HAVING briefly reviewed the first lecture, Dr. Stone proceeded to say that he had estimated the electrical resistance of the human corpse by inserting silver needles through the skin into the flesh, by which means the influence of the insulating, badly conducting skin was eliminated. The result showed that the estimations made on the living human body were correct, for the resistance was found to be slightly higher—at all events, it was not lowered. The chief topic of the second lecture was electrolysis as it occurred in the human body. All fluids acted as electrolytic agents, and so also bodies imbibed with fluid. The classical works of Dubois-Reymond and Count du Moncel on human electrolysis were noticed. The lecturer then exhibited an artificial electrical schema, in which the solutions and poles employed were the same as he had made use of in his determinations of the electrical phenomena of the human body. That polarisation takes place was very evident, and it appears, when physically studied, in the form of increased resistance. The work of Dr. Waller and Dr. de Watteville, published in the Philosophical Transactions of 1882, was also referred to.

As it is clear that electrolysis goes on during the passage of a current of electricity through the body, it is equally clear that there must be an accumulation of electromotive force in the body. The body is therefore a secondary battery which can be charged with electricity; at least, that

is one way of interpreting the facts of experiment. The body can be charged, and, having its charge, it can also discharge. This fact was demonstrated to the audience by means of the galvanometer. It was first tried on the artificial electrical schema, and then on a living man. An initial "throw" or deflection of the galvanometer was observed when the charged schema or man was brought into electrical communication with the galvanometer. The initial "throw" subsides rapidly at first, but a permanent deflection of the galvanometer remains for some time, showing of course that the body or schema was still discharging. As to this capacity of the body to become charged and to discharge itself, Dr. Stone used to consider that it was of the nature of a condensation of electricity by the body, but he has modified his earlier views owing to certain investigations of Prof. Hughes; so that he now believes, with the last-mentioned authority, that it is a matter of self-induction of the body. The initial "throw" of the galvanometer represents this induction, and the permanent deflection corresponds to the counter-electromotive force. The discharging current continues steadily and for a much longer time than was anticipated.

The results of some observations on certain cases were next given. In one case of sciatica where the leg was greatly wasted, and in which the resistance was somewhat high, the man was charged for thirty minutes with ten bichromate cells, the current passing from foot to foot. The initial "throw" was represented by 250 divisions of the scale. That this was really due in great part to the patient was proved by eliminating the possible influence of the lead contacts. The second case was one of diabetes. The patient was charged with a constant current of fourteen volts for half an hour, passing from the forehead to both feet, in a vessel of water. The resistance was found to be 600ω , or after correction by Mance's method 543ω . This case gave a polarisation current of no less than 137 ohm . The electro-therapeutical treatment of diabetes had been shown to be of transient value by M. Semmola. A third case, also of diabetes, was next related. The patient was very ill. His resistance was 1100ω , or 1020ω after correction by Mance's method. He gave a polarisation current equal to 145ω , a very large counter-electromotive force, much larger than has ever been expected.

The resistance of the real man is somewhat less than that of the schema. As experiments already made by Dr. Stone with Mr. Lant Carpenter have shown, the resistance is increased by the polarisation resulting from the passage of the current. The charged body discharges very much after the fashion of a secondary battery. This information opens up a field of speculation in electricity as applied to the animal, and more especially to the human body. Even after but two volts have been used in the charging process, the body continues to discharge electrical force for several hours. Allowance being made for the swing of the galvanometer needle, it was shown that a current as feeble as two volts had the capacity to develop a counter-electromotive force which could be detected for some hours after the charging force had been removed. Two volts was a very feeble driving force, and only just sufficient to oppose and overcome the normal resistance, which might be appraised at about one volt. The electrostatic capacity of the body might be differentiated into a special capacity for condensing electricity and a capacity for electrolysis. But it is very doubtful whether a differentiation ought to be attempted; it was better to say that self-induction of the body took place. These researches have a very important bearing on physiological matters such as the phenomena of "electro-tonos." Dr. Stone averred that he had always been sceptical as to the reality of electrotonos. The inconstant and variable results obtained by various authors working at this phenomenon were alluded to. Rosenthal admitted that the rise and fall of the electrotonic state sometimes went one way and sometimes another; and the paper by Dr. Waller and De Watteville, which quoted Fick, Eulenberg, Erb, Sanft, and others, showed what opposite conclusions had been come to. It had been suggested that the inconstant results were due to inconstancy of the nervous matter. But the lecturer humorously suggested that it was too bad to saddle the nervous matter with such inconstancy. The statements of Rosenthal were all consistent with conditions due to polarisation. He considered that too much stress had been laid on physiological points; no care had been made to ascertain whether the physical agent employed was always uniform. Anode and cathode were purely fictitious terms; the current might,

for aught we knew, go in the opposite direction. We do know, however, something real about the two terminals and that related to electro-chemistry. The so-called positive terminal oxidises, whilst hydrogen is liberated, and bases are separated from the so-called negative pole. We know also that the passage of the current in the same way produces in the living human body a secondary battery of no inconsiderable power. Again, the phrases "cathelectrotonos" and "anelectrotonos" were unscientific; with weak currents the rise of cathelectrotonos was said to be near the anode; what was the meaning of that? It was probable that the phenomena of electrotonos ought really to be regarded as effects of electro-chemical decomposition in nervous tissue of a polarisation kind. Again, such inaccurate expressions as currents of medium strength were held up to deprecation; we ought to know what the intensity of the current was in amperes. If the electromotive force of the current is sufficiently strong to overpower the counter-electromotive force of the body, electrolysis will take place. But no means have been taken to measure this. Rosenthal admits that the effects are inconstant. There is also a possible error in the tetanising key of Dubois-Reymond, which did not cut off the current entirely from the long circuit. Here the law of inverse proportions also held good; most of the current goes through the short circuit, but some still traverses the long circuit, and this was another source of inconstant effects. If the induction coil be added to the constant current, the problem becomes infinitely more complicated and physically past accurate solution; if the induction coil alone be used, the problem is sufficiently complex. According to Waller and de Watteville,¹ the laws of diffusion are the same for each current; but Dr. Stone asserts that this is a distinctly false assumption. The induced current meets with but half to two-thirds the resistance of the constant, the exact proportion being 1141ω to 575ω . In believing that they had to deal with physiological signs alone, authors had fallen into error. As above shown, Dr. Stone maintains that the physical constants have not all been determined. Another point that has stood in the way of accuracy was the employment of over-sensitive galvanometers. Again, the entirely empirical indications of the galvanoscopic frog, no two of which have the same constants—nor can these be determined,—gave false results. So that whilst allowing that the phenomena, though admittedly inconstant, have been well and carefully observed, the lecturer was decidedly of opinion that much of the inconstant results—laboriously misunderstood and ingeniously misinterpreted—would prove to be due to purely physical conditions. The lecturer then demonstrated the telephone method of detecting and estimating electrical currents. It was a method of great delicacy, and had the inestimable advantage that it could be commanded, controlled, and measured. It might take the place of the galvanometer in Wheatstone's bridge, for the telephone could be silenced when the resistances in the two coils were equal.

A CASE OF SO-CALLED HYDROPHOBIA; WITH REMARKS ON THE NATURE AND TREATMENT OF THIS DISORDER.

By CHARLES W. DULLES, M.D.,

FELLOW OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA AND OF THE ACADEMY OF SURGERY, SURGEON TO THE OUT-PATIENT DEPARTMENTS OF THE HOSPITAL OF THE UNIVERSITY OF PENNSYLVANIA AND OF THE PRESBYTERIAN HOSPITAL IN PHILADELPHIA.

ABOUT two years ago I had just completed the preparation of a paper on the "Disorders mistaken for Hydrophobia,"² in which I had attempted to describe systematically the sources of error which I believed to lie at the foundation of a large number of diagnoses of hydrophobia, when I was suddenly summoned at midnight to the assistance of a colleague who had the care of what he thought to be a case of this disorder. The occasion was welcome, as affording me a new opportunity to study clinically this subject, which has so much engaged my attention; but it was also trying, since I felt that at this very time any error—although it might be due solely to my own incapacity—would seriously compro-

¹ Phil. Trans., p. 963.

² See Transactions of the Medical Society of the State of Pennsylvania, vol. xvi., 1884; also Reprint, 8vo, pp. 37, Philadelphia, 1884.