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ON
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BY
WILLIAM STEVENS, M. D.

&c. &c.

READ AT THE ROYAL COLLEGE OF PHYSICIANS,
MAY 3, 1830.

LONDON :
BURGESS AND HILL, GREAT WINDMILL STREET.

MDCCCXXX.

OBSTRICTIONS

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CHARLES WOOD AND SON, PRINTERS,

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OBSERVATIONS ON THE BLOOD.

THERE is sometimes met with in the West Indies a malignant form of the yellow fever, in which, from the beginning to the end, it is evident from the symptoms, that there is during life little or no affection of the solids ; and, often after death, even the most able anatomist cannot detect any trace of disease, either in the brain, the stomach, the intestines, or any of those organs, whose derangements are generally supposed to be the cause of fever. In those fatal cases, there is no excitement in the commencement sufficient to injure the solids, and we can only ascertain the real cause of death, when we open the heart, and examine the state of the once vital fluid. The cause of death then becomes evident ; for we find there, in place of blood, a dissolved fluid, nearly as thin as water, almost as black as ink, and evidently so diseased, as to be totally incapable of either stimulat-

ing the heart, or supporting life. In both cavities of the heart, the fluid is equally black, and in the whole vascular system, all distinction between arterial and venous blood is entirely lost. A close attention to some of these cases first led me to believe, that in fever the influence of the nervous system was greatly over-rated, and that the blood was infinitely more concerned as a cause, and the solids less than is generally believed. This and some other circumstances induced me to pay particular attention to the blood, to make a number of experiments, and to form some opinions with respect to this fluid, some of which I now submit to the Royal College of Physicians, with that diffidence which every one must feel, who is fully aware how much all human reasoning is liable to error, particularly where the subject is so mysterious, and as yet so little understood.

It has been the fashion for nearly a century past almost entirely to overlook the importance of the blood, and all those changes that take place in the vital fluid, either as a cause of morbid action in the solids, or as a consequence of disease. Yet, to the physician, a knowledge of these

changes is valuable beyond all calculation. The effects of these derangements in producing disease, the changes that are produced in the circulating current by active agents, the manner in which these agents act, either as a cause or as remedies in disease, form by far the most important part of the study of medicine. My reason for the belief, that fever is produced by a deranged state of the blood, and that death in bad fever is often caused by its dissolution, will afterwards be given; but for the moment I may be allowed to say, that this long and entire neglect of the vital fluid is perhaps the chief reason why we have been going back in the theory of fever, and that too at a time when such brilliant improvements have been made in almost every other part of medical science. But, perhaps, the true value of a healthy state of the blood will be best proved by the study of its derangements, and the effects which these derangements produce on the solids of the system.

On examining, soon after death, the black and dissolved blood that had been taken from the heart of those who had died of the

yellow fever, it^d was very evident, even at first sight, that several great changes had taken place.

1st. The blood was more fluid than natural, partly from an excess of serum, probably produced by a stoppage of the secretions and the retention of those fluids in the system, which ought to have been thrown out by the secreting organs ; but independently of this, in these violent continued fevers, as little nourishment is used, the fibrin or solid part does not appear to be formed in its usual quantity, and perhaps also, it is exhausted faster than in health, in supporting the high and continued excessive heat, that is so great in the commencement of the inflammatory form of that fever. In the first stage of the disease, the structure of the red globules is frequently deranged, which is evident from the fact, that in those fevers, the colouring matter is often detached from the globules, and dissolved in the serum, giving to that part of the blood, when it separates from the fibrin, a bright scarlet colour, and this colouring matter cannot be separated from the serum, either by filtration, or any other mechanical means ; but

as the disease advances, this red colour is lost, and the whole circulating current becomes black and so thin, that it has no longer any resemblance to the blood of health.

2d. The colour of the whole mass of blood, both in the arteries and veins, was changed from its natural scarlet or modena red to a dark black. I have frequently filled one glass with the black fluid taken from the heart, and another with the black vomit taken from the stomach. They were both so unlike the blood of health, and resembled each other so completely, that it was almost impossible to distinguish the one from the other, and from its appearance it was very evident that such diseased blood could no more stimulate the heart or support life in the solids, than putrid water can nourish vegetables, or carbonic acid gas support respiration.

3d. In violent continued fevers, the saline matter, like the fibrin, appears to be exhausted faster than it enters the circulation; the blood soon loses a great proportion of its saline impregnation, it loses entirely its saline taste, and we shall afterwards see that the black colour is a certain proof of the

entire loss, or at least of the great diminution of the saline matter.

4th. The blood, though dissolved, was not yet putrid, for the blood is so essential to life, that putrefaction of this fluid cannot exist in a living body. But dissolution is the first step towards putrefaction; and when this to a certain degree takes place, death of all the solids must follow. I may here add, that this dissolved state of the vital fluid was the cause, and not the effect of death; for I have sometimes seen the blood, even previously to death, both black and so thin, that it could scarcely be retained within the vessels; and occasionally it has been observed oozing from the tongue, the eyes, the skin, and other surfaces, where there was not even the slightest lesion.

The dissolved state of the blood is the effect and not the cause of fever. But as it was evident in many of the fatal cases, that this dissolution was the sole cause of death, it then became an object of importance to find out some agent capable of preventing this fatal change in the whole circulating current.

In all climates nature has given to the

waters of the deep, the power of self preservation, and this power they probably owe partly to their saline impregnation. It is also well known, that some of the saline medicines possess great antiseptic power, and those who wish to preserve either the animal solids or fluids, even after death, find these saline substances by far the most effective agents. Saline matter is also invariably found in healthy blood, and the presence of this seems actually necessary to its healthy state ; for, when it is lost in disease, the vital fluid goes fast to decay. As this saline matter was lost or greatly diminished in the blood that had been dissolved in bad fever, and as the loss of this was probably the chief cause of the mortality, I was induced to try the effects of the saline medicines in preventing the bad symptoms that are so generally met with in the fevers of hot climates ; and, after having used several of the saline medicines in a great number of cases, I was completely convinced that those agents had, when used at a proper period of the disease, a specific effect in preventing the dissolution of the blood. In all the cases in which they were timely and properly admi-

nistered, they prevented the bad factor in the breath, the stoppage of the secretions, the yellow colour in the skin, the black vomit, and the other fatal symptoms which were so common in those cases when these medicines were not used.

After having often witnessed the specific effects of the saline medicines in preventing the mortality in bad fevers, and recollecting that several of the neutral salts enter the circulation without undergoing any decomposition in transitu, I was induced to try what effects these agents would have when mixed with the blood itself, while it was still warm and fluid, and just drawn from the system. I was in some degree prepared for the result of these experiments from having so often seen the powerful effects of these medicines in remedying the diseased state of the blood, even in the most aggravated forms of bad fever.

It is well known, that the saline principle is formed by the complete saturation of an acid with either an alkali or an earth. An immense variety of agents are produced in this way, but they all possess some properties in common. Some of them are

formed by nature, others by art ; but however formed, they produce the most striking and important effects both in animal and in vegetable life, they possess new properties totally separate and distinct from any of the substances from which they were originally formed, and one of these new properties is the power which every one of them possesses of giving a rich arterial colour to venous blood. This property is common to them all, and the degree to which they possess it is perhaps the best test of their purity as saline agents.

Whatever that animal substance may be which gives to the blood its colour, it is evident that these agents, which change the colour of the blood, must do so by acting on the colouring matter. To ascertain the effects of different agents on the blood, I made a number of experiments, and in these it was observed,

1st. That all the acids give a dark colour to the colouring matter of healthy blood ; and in proportion to their strength, they change the colour from red to black, as certainly as they change vegetable colours from

blue to red. When any one of the acids was diffused in a little water, and then mixed with the fluid blood, the colour of the whole was immediately changed from red to black. Even the vegetable acids so completely blackened the blood, that the addition of a little water converted the whole into a fluid exactly resembling the black vomit.

2d. The pure alkalies have a similar effect with the acids in changing the colour of the blood from red to black, though not in the same degree.

3d. The neutral salts immediately changed the venous blood from a dark modena red to a bright arterial colour. Even those salts that contain a slight excess of alkali, the subcarbonate of soda for example, immediately give to venous blood a beautiful bright arterial colour*.

4th. When the neutral salts were mixed with the dark and dissolved blood that had been taken from the heart of those who died

* The effects of these experiments are best seen when they are made on healthy blood, the agents ought first to be dissolved in a little soft water, and then well mixed with the warm blood before it begins to coagulate.

of the yellow fever, even this black and dissolved fluid was immediately changed from black to a bright arterial colour.

Nature does nothing in vain, and all the analyses of the blood have proved, that in health, it invariably contains a given proportion of saline matter. This is not accidental, for it is as essential, and exists as invariably in healthy blood, as either the fibrin, the albumen, or the colouring matter. Arterial blood must evidently contain a larger proportion of this saline matter than venous; for all the solids and most of the secretions derive their saline matter from arterial blood. But the serum of even the venous blood which is left, contains a proportion of thirteen ounces to the thousand of these salts, independently of what is lost by evaporation, &c. We well know how active these salts are as chemical agents, and these agents are so constantly found in the blood, and in healthy blood their proportion is so exact, that we are forced to believe that they are placed there for some important use. “In the study of anatomy, every man proceeds on the maxim, that nothing in the body of an animal was made in vain, and when he

meets with a part of which the use is not obvious, he feels himself dissatisfied till he discovers some, at least, of the purposes to which it is subservient *."

It is very evident that the saline matter in the blood serves more important purposes than one ; but the importance of this saline impregnation has been almost entirely overlooked, from the great attention that has been paid both by physicians and philosophers to the much less important colouring matter.

The nature of this paper prevents me from entering minutely on the important effects, which this saline impregnation produces in the vital fluid ; but, in a work which will soon be published, I shall endeavour to prove first, that the blood owes its red colour to this saline impregnation. Black appears to be the natural colour of the colouring matter ; for, when we take a clot of blood, and deprive it completely of its saline matter by immersing it in fresh water, the colouring matter soon becomes so black, that even oxygen has no effect in changing its

* Stewart's Outlines of Moral Philosophy.

colour. But when we immerse this black clot in an artificial serum, made by dissolving some saline matter in water, the black clot in this clear fluid assumes almost immediately a beautiful bright arterial colour. Secondly, that to this saline matter, the fibrin owes its fluidity, for it remains fluid only while mixed with the saline matter, and becomes solid when the saline matter leaves it to unite with the serum. Thirdly, that the change of form which this saline matter undergoes, when the blood changes from arterial to venous, and from venous to arterial, changes its capacity for caloric, and gives it an influence in supporting the temperature of the system. The saline impregnation also adds to the stimulating quality of the blood, and assists even in a high temperature in adding to its power of self-preservation.

In their present state, both medicine and its dependent connection animal chemistry are far from perfection. In these the doctrines of yesterday are but too often overturned by the doctrines of to-day, and so long as theories are constantly changing, we may perhaps best gain our end by simply

resting on facts ; and the facts that I will endeavour to establish are partly these,

1st. That in violent continued fevers, even where proper means are used to protect the organs by reducing the excitement, chemical changes often take place in the whole circulating current ; and in these fevers, these changes are almost always the sole cause of the mortality. In proportion as the disease advances, the blood loses its solid part, and becomes thin ; it loses its saline matter, and becomes both black and vapid ; it loses its preservative power, and goes fast to decay ; it loses its vitality, and in a short period becomes totally incapable of either stimulating the heart, or supporting life. The degree, to which these changes take place, is in proportion to the malignancy of the disease. In the yellow fever, in the African typhus*, in the plague, &c., dissolution of the blood is a common cause of death. The typhus of cold countries is comparatively speaking a mild disease ; but even in the common typhus similar changes take place in the blood, though in a less de-

* Or the Bulam fever of Chisholm.

gree. This has been clearly proved by the important experiments of Dr. Reid Clanny, of Sunderland.

2d. In all cases of bad fever, the loss of the saline, or preservative power, appears to be in every instance the chief cause of the entire dissolution of the vital fluid.

3d. Where proper means are used to protect the organs from the increased excitement during the early stage of the disease, and after the excitement is sufficiently reduced, when proper nourishment is given, and certain saline medicines are timely and judiciously used, the bad symptoms are generally prevented. When proper saline medicines are used, they do not fret the stomach, they act on the intestines as much as is necessary, they keep up all the secretions, particularly that of the kidneys, and enough is absorbed to enter the circulation, and prevent the dissolution of the blood, and preserve it until the fever abates, and all the danger is past. This I am warranted to state as a fact, inasmuch as this treatment was commenced in the West Indies, in 1827; and since then it has stood the test in several hundred cases of the West India Fevers,

where it has been tried both by myself and others, and with scarcely a single loss when we were called to the patients within the first twenty-four hours after the attack, and with very few deaths where we were called in previously to the commencement of the fatal symptoms. My friend Dr. George William Stedman, now of St. Thomas, and others, have adopted the same treatment, and the result in their practice has been similar to that which occurred in my own cases.

In August, 1828, at a time when there was a good deal of sickness in the garrison at Trinidad, this practice was adopted in the military hospital of that island; that is to say, they bled freely, and used active purgatives in the commencement, to reduce the excitement, and afterwards the saline medicines were administered until the fever abated, and during the convalescence, the quinine was given in large doses. In a communication which I received from Mr. Greatrex of the royals, who at that time had charge of the hospital, he states, "that the above system has been applied to three hundred and forty cases, or thereabouts, including both the remitting and yellow fevers admitted into

the hospital, after the fever had existed variously from six to seventy-two hours antecedently to an application to the hospital, with such success, that during the last seven months not a case had died." This document is dated about seven months after the commencement of this practice. Mr. Greatrex also states, that within that time three men died having the remitting fever, but they had also abscesses in the lungs, and purulent expectoration. As these three cases were complicated with extensive organic disease in the lungs, it is probable that they would have been fatal under any treatment. But out of the three hundred and forty cases of essential fever, which had been treated in the manner described, there was not even one death in the royals, from the time that this practice had been adopted; and I may add, that in the West Indies, Trinidad is generally considered as one of the most sickly islands.

It can be clearly proved, that in the West India fevers, these patients that are left entirely to themselves have a much better chance of recovery than those who are treated with emetics, calomel or antimony,

opium or acids; and that these remedies instead of being useful add greatly to the sufferings of the patients, they decidedly increase the very evils that they are meant to relieve, and add greatly to the mortality in hot climates.

It is I believe an error to consider fever as entirely a disease of the solids, and still more so to treat it solely with a reference to the mere state of excitement; at least this much is certain, that those, who attend only to the solids and the mere excitement, can never cure even one case of the yellow fever that is really severe. Such cases can only be treated with success, when we reduce by active treatment the increased excitement in the commencement, and then prevent by chemical means those chemical changes in the blood, which are in reality the source of the diseased action in the solids, and the true cause of the mortality in these fatal fevers. After having seen much to convince me that this is the fact, I adopted a mode of treatment widely different from that which I had formerly used; and, in as far as it has yet gone, the use of the Rochelle salt, the carbonate of soda, and other active saline medi-

cines at a proper period of the disease, has been attended with a run of success, to which the mere solidists can produce no parallel; and having so often seen this mode of treatment fairly put to the test, I am induced to believe, that if this practice is generally adopted, the mortality from fever in hot climates will be greatly lessened. So long as we considered fever as a disease of the mere solids, and treated it as such, we had no command over the disease; but from the moment that we considered fever as a disease of both the solids and the fluids, and met it accordingly, we have been able to prevent much suffering, to save many valuable lives, and in those islands where this treatment has been fairly tried, that hitherto fatal disease, the yellow fever, has in a great degree been disarmed of its terrors.

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