

THE JOURNAL OF MENTAL SCIENCE.

[*Published by Authority of the Medico-Psychological Association.*]

No. 68. NEW SERIES,
No. 32. JANUARY, 1869. VOL. XIV.

PART 1.—ORIGINAL ARTICLES.

On the state of the Small Arteries and Capillaries in Mental Disease. By W. H. O. SANKEY, M.D., Lond., F.R.C.P.,
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(*Read at the First Quarterly Meeting of the Medico-Psychological Association,
held at the Royal Medico-Chirurgical Society, Oct. 29th, 1868.*)

AMONG the structural changes which may cause the phenomena observed in insanity, physiology leads us to the conclusion that they must be connected with, firstly, the nerve tissues, and, secondly, the blood. It teaches us that upon the action that takes place between these elements the phenomena of mind depend.

In studying the morbid anatomy of the disease, our attention must be directed primarily to these, which may be called the essential elements, and, secondly, to their containing organs, which may be called the secondary elements.

The containing organs of the nerve elements consist of the bony and membranous envelopes.

The containing organs of the blood are the blood vessels.

In the present paper I propose to confine my remarks mainly to the state of the latter of these secondary organs, namely to the blood vessels.

I have selected this portion of the subject, not only to confine my paper within a reasonable limit, but because already a very large share of the attention of physicians has been

hitherto engrossed in the examination of the membranous and other containing organs of the nerve tissue.

I am not going to claim for the blood vessels an all-important function in the act of cerebration, yet I am disposed to think the part they play in this function has not been duly acknowledged.

Physiology supplies us with certain data on which we may estimate the importance of the function performed by the vessels.

These data are, briefly.

1. That each act of cerebration (which results from an action of the blood and the cerebral tissue) requires that the blood be unimpaired in quality and of a just quantity.

For, that blood impaired as to quality produces imperfect cerebration has been proved by the injection of poisons into the blood, by the action of certain drugs which are known to enter the circulation, &c.

And that blood supplied in altered quantity interferes with the proper action of the cerebrum, has also received abundant proof experimentally—as when syncope, unconsciousness, convulsions, are produced by a withdrawal of blood from the cerebral circulation.

The second datum supplied by physiology that I will cite is that the normal property of the vessels is to so vary from time to time as to degree of fulness.

With respect to this fact we have also the following:—

1. That the change from fulness to the opposite condition occurs normally in sleep.*

2. That the same is known to occur as a morbid phenomenon, as in all kinds of congestions.

3. That this alternation of fulness or comparative emptiness of the vessels appears to obey, in certain cases, a law of periodicity, as I. normally, in the periodical disposition to sleep; or II. abnormally, in the recurrence of the hot and cold stages of ague—in tic, &c.

4, and lastly. That the state of the vessels is known to be affected through a mental influence—as in blushing, or pallor, or fright, &c.

Anatomy points out the free communication that exists by

* Durham on the Physiology of Sleep, Guy's Hospital Reports, Vol. VI. p. 149.

means of the sympathetic system between the cerebrum and the vessels.

Anatomy also explains how the variation in fulness of the vessels is affected by the agency of the muscular coat of their walls.

Dr. George Johnson, in his very suggestive papers on this subject, has lately sought to show how the phenomena of rigors and epilepsy may be explained by the agencies of the vessels.

He explains the action of the small arteries to be that of regulating the amount of supply to an organ by their power of contraction, and that the action of these arteries may be compared to a system of stopcocks, which prevents a too great flow of blood to an organ, or the passage of a blood of an impaired quality to the ultimate tissues. This view of the action of the vessels in question has received the assent of many physiologists, in contradiction to the view once entertained that the use of this muscular coat was simply and wholly propelling.

Dr. Johnson found that in advanced renal disease the small arteries of the tissue, not only of the kidney, but of the skin, and also of the *pia mater*, become in some cases enormously hypertrophoid, so much so that whereas, normally, the walls of a small artery of the *pia mater* collapse, and show by transmitted light but very faint outlines at their edge, in some of his cases the walls showing on each side of the calibre of the vessels were wider than the calibre itself.*

His explanation is that these walls become hypertrophied as the ordinary result of over-work, that in certain cases the heart itself becomes thus hypertrophied to overcome the resistance caused by the smaller vessels, and thus by a kind of antagonistic action, both parts increase in thickness.

The effect of the hypertrophied heart, therefore, must be always borne in mind in estimating the alteration observed in a small artery.

I have been anxious to examine the views of Dr. Johnson in connection with certain phenomena of mental disease, not only because a fixed and constant seat of morbid change, in cases of mental disease, has not been satisfactorily proved, but also because certain of the known properties and functions of the vessels, as already stated, appear to correspond with

* A drawing of the appearance of small artery was exhibited, showing its normal thickness.

certain of the phenomena observed in insanity—namely, many of the phenomena of insanity are not of fixed character, as the frequent changes often observed in the same case from grave to gay, as in those cases called “Folie Circulaire,” in which a state of melancholy mania and a lucid interval often alternate with regularity; as in the occurrence also at periods of more or less regularity of paroxysms of violence; the occurrence of a distinct lucid interval in patients apparently demented; in the frequently mentioned circumstance of an old lunatic becoming rational just prior to death: all these seem to point to a changing or shifting cause as the seat of the disease, rather than to a permanent one.

Now since similar phenomena may be produced experimentally—first, by altering the quantity of the blood by abstracting a portion of the supply; secondly, by altering its quality by the introduction of foreign elements; and that both of these, if produced by disease, may, as shown by Dr. G. Johnson, *leave their traces* upon the structure of the arteries, I have thought an examination of the arteries would be of value.

I offer my own observations and my reasons for undertaking them rather to induce others to follow out the enquiry than from any supposition that any real result can be expected at this stage of the investigation.

I have submitted to a very careful re-examination sixty-eight specimens of arteries taken from twenty-five cases of disease, of which 8 were cases of general paresis.

7	”	dementia.
7	”	chronic insanity.
2	”	epilepsy.
1	”	acute mania.

And I compared the tissues with those of five persons dying sane.

Of the eight cases of *general paresis*, I found slight thickening of the walls of the small arteries in one only; it was slight in degree; in the rest of the cases the condition of the walls appeared as in normal brains; while the state of the capillaries was more or less changed in all—in most of them there was some indication of varicosity. (The drawing No. 2, sketched from the appearances observed, was exhibited.)

Among the seven cases of *dementia*, but which, with two exceptions, were of patients dying in advanced years, there was some degree of hypertrophy of the walls in all but one; this patient was the youngest of the seven, and was about 35 years of age. In some of the arteries of this case there was

a slight disposition to the same condition as shown in sketch No. 3. (Handed round.)

In one case, that of a patient who died in 1862, and who was the first patient admitted into Hanwell Asylum and who had been insane several years prior to admission, the small arteries were greatly hypertrophied. (A drawing from the specimen was shown, and the vessel in this case fell into curves more like in contour to a flexible stethoscope than a membranous tube, and the smaller arteries showed a small calibre running through a thickened vessel).

In No. 5 (sketch exhibited) the lining membrane of the vessel had taken the stain* and showed an irregular outline; the vessel fell into folds like those of a stiff tube, and the vessel remained patent. This was taken from an aged person.

In the seven instances of *chronic insanity* the arteries varied greatly in character. In four there was a decided increase in the walls of the vessel.

The drawing No. 6 showed the appearance of the small arteries in a patient who had that form of disease called "folie circulaire." She was 35 years of age at the time of death, and had been insane several years.

Among the other preparations some of the specimens exhibited greater and one or two a less degree of thickening of the walls of the small arteries.

Lastly, I failed to detect any alteration in one case of the chronic dementia as to thickness of the same vessels, but the capillaries were twisted and varicose to a great degree. This patient died of locomotor ataxy.

The cases of *acute disease* and *epilepsy* appeared to present no deviation from the normal condition.

Lastly, though there is a great variety in the appearance of the individual cases, no two being altered precisely to the same degree, or giving a very similar appearance in the state of the *small arteries*, the appearance of the *capillaries* of all the cases of general paresis certainly appeared to me to give a much greater uniformity of character; in five out of the seven there was a distinct varicose condition: but the same condition was found also in one of the other cases.

I will only add a few remarks upon the above observations, merely to indicate the impression that is left upon my own mind by the enquiry thus far carried out.

The large number of the cases of chronic insanity and im-

* Most of the preparations exhibited were stained with Litmus.

becility, or dementia, in which the hypertrophy of the arteries was found, appears to point to the following conclusions:—

1.—That the muscular coat of the arteries in these cases, at one period of their progress, has had an excessive amount of work to do.

2.—That the cause of this excessive work has been probably either (A) the existence of an impure state of the blood; which is rendered probable from the occurrence of (*a*) certain symptoms connected with mal-assimilation in the early stage of the disease, as heart-burn, flatulence, constipation, and other dyspeptic symptoms; and (*b*) certain other phenomena, common in the insane, observed in a later stage, and connected with the blood-making organs, as disease of the heart, kidneys, and lungs, the existence of which is verified by post mortem inspection, and shown by symptoms during life as palpitation, throbbing of the arteries, and distinct signs of actual heart disease,* &c., &c., or (B) the excessive action may be due to direct nervous influence. When the hypertrophy of the peripheral vessels is due probably to excessive force in the central organ; for excessive action produced by over excitement in the part itself, would be less likely to produce both the morbid cause and the healthy antagonism to counteract its effect.†

It would appear also highly probable, while the state of the blood (or other cause) thus gradually induces a permanent hypertrophy of the arteries, that when the case has passed into a more chronic condition, this state of the vessel becomes a cause of imperfect blood supply to the organ, the balance of power between the propelling action of heart and the regulating or arresting power in the capillaries is disturbed, and the cerebral circulation is thus interfered with; and this appears to be so because such an impediment as the muscular power of the artery is one that might vary from time to time in degree, for the condition of the arteries

* Esquirol found heart disease in $\frac{1}{3}$ of his cases; Webster, $\frac{1}{2}$; Bayle, $\frac{1}{2}$; Calmeil, $\frac{1}{2}$; Sutherland, $\frac{1}{4}$; at Vienna, in $\frac{1}{4}$.

† There is little doubt from Dr. Johnson's observations that hypertrophy of the heart is found in conjunction with hypertrophy of the walls of the small arteries; but it is obvious if the hypertrophy of one is balanced or adjusted by the increased power of the other, no ill effect would result. Dr. Johnson tells me that in certain of his cases in which hypertrophy of the walls of the arteries of the pia mater existed to an extraordinary extent, there was no marked cerebral disturbance till just preceding death. It is much more probable that in insanity the impure condition of the blood induces the hypertrophy.

is known to undergo periodical change, as in sleep,* ague, &c. And there is scarcely any case of imbecility which is not subject to periodicity. In some imbeciles, excitement is on alternate days, with great regularity; in some the variation is less frequent; in others, less regular, &c., so that the normal law of periodicity of function exists in conjunction with the abnormally increased force.

Even in cases of advanced dementia, &c., in which it may be inferred that the circulation must be interfered with to the greatest degree (if such be the explanation at all of the phenomena) it is well known there will often occur a distinct lucid interval. We can imagine that a cause might arise in such a case, or causes might conjoin to produce a relaxation of the hypertrophied arteries. We can easily conceive how the period just preceding death might have the same effect on the arteries, and thus cause what is known frequently to take place, while a periodical and transient repair of a diseased nerve element seems far less probable.

Thus the occurrence of the phenomena in certain cases appears to obey the following order of succession:—

1. An alteration in the quality of the blood. 2. Excessive work of the small arteries of the brain. 3. Hypertrophy of their muscular coat. 4. Interference with the cerebral circulation; and 5, deficient nutrition of the organ; or, the first item may be incorrect, and the second may be called forth by what stimulates the nerve force of the arteries themselves, as mental influences, or such like.

While, 2ndly, the appearance of the arteries found in the cases of general paresis seems to indicate a different order in the succession of the phenomena. In these cases there appears to be, as a rule, absence of all increase in the walls of the small arteries, but in place of it we find extreme varicosity of the capillary, and kinking and twisting of them. This condition would seem to indicate that from some cause there has been, at some period, a greater influx of blood sent to the brain than could be as quickly passed onwards; and hence arose a varicosity of the capillaries.

If the function of the muscular coat of the small arteries is rightly attributed to be that of checking or regulating the amount of the blood supply, the condition would indicate that

* "Whatever increases the activity of the cerebral circulation tends to preserve wakefulness; and whatever decreases the activity of the cerebral circulation, and at the same time is not connected with the general health of the body, tends to induce and favour sleep." Durham, loc. cit.

this interposing function was at fault; that no alarm, as it were, was felt by those vessels; that this action, in fact, was involved in the general paralysis.

If such is the case, the paralysis must be of the nerves supplying these vessels—that is, the sympathetic. That this division of the nervous system is really involved in the general paralytic condition of the patient is abundantly shown during the progress of the symptoms, and from the above appearances it is probable that the loss of power commences in the sympathetic system as early as in the rest of the nervous functions.

Such are the suggestions that have occurred to my mind while occupied in examining the specimens in my possession. My object would be misconstrued, however, if I am supposed to claim implicit acceptance for these reflections, drawn as they are from too few observations to establish any absolute conclusion. But the remarks may serve, I trust, to direct a more close examination of the state of the small arteries in the different forms of mental disease.

Appendix. Perhaps I may be allowed to add a few remarks which could not very well form part of the paper itself, as what I have to say is rather of a negative character than the opposite. I wish to guard myself from being understood to say that I locate the seat of all the morbid changes of insanity in the arteries of the brain. A careful reading of the paper itself will, I trust, protect me from such an error. Such changes as are found in the small arteries I look upon rather as a mark left behind, and which shows the footsteps of the progress of the disease, rather than constitutes the morbid anatomy of the disease. I have treated them as belonging to secondary, rather than the essential elements of the pathology. The appearances found were illustrated by drawings taken from the preparations, I do not reproduce them here lest those who look at illustrations only should be misled by them, for I cannot but think that such has been the cause of the error which I find propagated relative to what I have stated elsewhere on the same subject. In a late publication I am first stated to hold certain views, which I do not, and then I am simply told that I am mistaken. It has in some way got into one or more authors' minds that I have stated that a varicose state of the capillaries is the morbid change to which all the phenomena of general paresis are attributable; that this varicosity of the capillaries is in fact the pathognomic character of the

disease. I think such an opinion quite erroneous, and I have always so stated. I have published two papers on this subject, one of which has been reprinted in France, and amply reported in Italy and Germany. In one of the papers in question I said in respect to this question, "there appears to be some amount of tortuosity in the capillaries in every case of general paresis. This tortuosity in places amounts to a simple curve or twist; in places to a kinking of the vessel; in others to a more complex twisting until it forms, in fact, little knots of varicose vessels of very complicated kind. I have not found this appearance in any other form of mental disease, but it is described as existing in other cases, both by Rokitansky and Wedl." In the other place I referred and reproduced the above, and added—"Since writing the above I have met with one case in which this condition of the capillaries was present."

But besides the question of the nature of the capillaries and as to the existence in them of a varicose state, there is another matter which I am accused of describing as abnormal while it is not so.

This refers to the real nature of what has been called perivascular canals. It appears to me that the existence of these canals has been exalted into unnecessary importance. That an intervening sheath existed between the walls of the artery and the parenchyma through which it traversed was readily to be believed—in fact it might have been prognosticated from what takes place in other situations, as in muscle, bone, &c. But that these canals, however, should vary in size and relation to the vessels contained within them, and should so vary in an inconstant degree, and still be the normal state of things, is contrary to my belief. That, in fact, these spaces should be three or four times the width of the vessel in one place, or in one brain, and not so in another, would be enough to prove the arrangement to be abnormal. It matters not whether the office of them is to carry nerves, absorbents, or for no such purpose, but surely there is in nature a normal condition. That the sheath, or tissues which surround the vessel, should in some cases adhere to the side of the perivascular canals, and in some cases adhere to the arteries, also tends to show that a change has occurred in connection with them. In my paper I merely stated that such appearances were familiar to me, and that I recognised the condition described by Wedl, viz., that sometimes this perivascular covering is transparent and sometimes opaque.

There is still, I think, nothing advanced to show why the sheath should, if normal, be sometimes transparent, sometimes opaque, sometimes closing adherent to the capillary or artery which it surrounds, and sometimes even inclose a small knot of varicose vessels.

I think it highly probable that the nerve tissue of the cerebral centres, especially in old cases, undergoes some change in its structure. I think the altered specific gravity of the brain indicates as much, but at present the microscope has not, I think, made the change palpable to our vision.

Note on the Localisation of Function in the Cerebral Hemispheres. By H. CHARLTON BASTIAN, M.A., M.D. Lond., F.R.S., Professor of Pathological Anatomy in University College, London.

MAN is born with a nervous system of the highest type, and in accordance with what we know concerning the laws of hereditary transmission, with one which—though at the time of birth so far advanced morphologically as clearly to foreshadow its future excellence—we are entitled to believe possesses within itself certain potentialities of organic development, definite enough and powerful enough to ensure its evolution in given directions, so long as its different parts are acted upon by those stimuli to which they have been accustomed in the preceding individuals of the parent race. To a certain extent the infant is even born already possessing capabilities of receiving impressions and of executing movements—corresponding parts of its nervous system being more advanced than others in histological development. And it may be stated generally, that these capabilities and these powers are gradually strengthened and extended in a definite order, as particular parts of the nervous system advance towards a more perfect development of tissue—that is to say, as nerve-cells and communicating nerve-fibres gradually arise out of the less specialised embryonic tissue which formerly occupied their place.

Although there is, therefore, a pre-arranged plan, so to speak, of development, and the several parts of the nerve-centres inherit a natural tendency to develop after a given