caped the observation of those who have expressly written on the subject, it shall be concisely noticed in this place, being connected in fact with the primitive symptoms of fever. The child of an able medical friend became somewhat heavy and indisposed, and as it had formerly had serious indications of cerebral disease, the father was alarmed lest they should return, and on this account at once applied a few leeches to the temples, and opened the bowels by a brisk purgative. The next night I saw the child, and except that the face was a little pale, the tongue a little white, and the appetite impaired, it appeared tolerably well, the pulse and heat of the skin being nearly natural, and all the great vital regions free from uneasiness. Mild laxatives and an antiphlogistic regimen were enjoined. During the night vomiting came on, and on the following morning early, I received an urgent message to visit the little patient immediately. Not having anticipated any mischief, I was shocked to find the child apparently in the collapse of death. The face and whole surface were as pale and cold as marble, the pulse a mere undulating, small line, the respiration short, weak, and irregular, the eyes fixed in a staring insensibility, and the muscles of the face and fore-arms occasionally convulsed. As the main object then seemed to be to restore the animal heat to a natural state, the child was immersed in a warm bath, afterwards wrapt in warm blankets, while warm diluents were diligently administered, with a very small portion of wine now and then. These means, with light support afterwards, removed the immediate threatenings of death, but the pulse still remained exceedingly oppressed, and the animal heat could not be raised to the natural standard over all the surface. In this state, a marked squint came on, the pupils grew dilated, and gradual but at last complete deafness and blindness, with an apoplectic oppression, supervened; yet all this time the pulse remained very feeble, and the skin cool, and it was only a short time before death, that re-action was emerged, from the irritation of the wreck previously effected. On examining the body, the viscera of the abdomen and thorax were perfectly sound: about three ounces of very thin serum were found in the lateral ventricles of the brain, without any vestige of inflammation. This was an extremely urgent case, but I have seen others similar in their nature, though less violent in their degree, and in all of them the symptoms of cerebral effusion came on when the skin was cool and the pulse oppressed, the febrile re-action having only appeared a little before death. Infants in arms are sometimes liable to such sudden attacks, when exposed to a chilling atmosphere, and they are then supposed to die from those convulsions which occur as a consequence of the disorder in the brain. The disease here spoken of is strictly one of venous congestion, and the effusion into the ventricles takes place from the capillaries, just as we see in an extremity when the return of venous blood is interrupted by compression. It has lately become the fashion to consider dropsical effusions as the result of inflammation, and certainly they are often connected with that condition; but there is one order of dropsy which arises from fulness of the venous system, influenced by the heart's action, of which the above case of hydrocephalus internus is an example in point.*

* The heart's action is still one of the most interesting subjects to investigate in physiology and pathology, and as it is intimately concerned in the rationale of the diseases immediately under discussion, I shall advert in this note to some positions which were formerly laid down in my treatise on the Scarlet Fever; though I did not know at the time, that one of them, respecting the power which circulates arterial and venous blood, had been anticipated by Dr. Carson, an ingenious physiologist, whose labours have not yet been estimated sufficiently high. 1. The auricles of the heart do probably not contract, like the ventricals, but would rather appear to be designed as reservoirs of blood, in order to keep up a regular supply for the correspondent ventricles; the dilatation of the latter being adequate to draw the blood from the auricles, which, if they had contracted after the manner of the ventricles, would surely have driven the blood into the descending cava on the right side, and into the pulmonary veins on the left. 2. Each ventricle of the heart performs the office of a forcing, and also of a sucking pump. 3. The contraction of each ventricle represents the forcing power by which the blood is driven out of the heart. 4. The dilatation of each ventricle represents what is popularly termed the sucking power, by which a vacuum would be formed in each ventricle but for the rushing in of the blood of each auricle from the air's pressure, as there would be a vacuum in a common syphon

Dropsical effusions may take place from the supply of blood by the arteries being so great that it cannot be duly returned by the veins, and this appears to be the case in those acute instances of hydrocephalus internus, where the heart's action is greatly increased: they may also take place where the sum

but for the rushing in of the water from the same cause. 5. The circulation of arterial blood is carried on by the forcing power of each ventricle indirectly assisted by the arteries; but the arteries themselves *generate* little or no mechanical power, and only expend the power which they had received from the contraction of the ventricle, in forcing by *re-action* the blood forward from the valves of the aorta; as a strained spring in recoiling gives out the power, to any thing attached, that it had received from their force to which it previously yielded. Some experiments were made, by a late physician of splendid talents,* by which it appeared, that the arteries, when laid bare, did not recoil from the stroke of the heart, which is the sole cause of the pulse, in the manner above mentioned; but an artery laid bare is not an artery in a natural state, and from marking that at the wrist and other places in emaciated subjects, I am persuaded that a dilatation and a recoil do actually take place; though both the arteries and the veins seem also to possess, from their proper irritability, the quality of accommodating their capacity to the quantity of their contents. 6. The blood in the veins of the general system and in those of the lungs is circulated by the dilatation of each ventricle, by the pressure of the atmosphere upon the veins, and perhaps by the hydrostatic law of fluids finding their own level, aided by the *vis à tergo* of the heart and arteries. 7. The circulation of lymph and chyle is carried on, not by any species of capillary action or of contractility alone, but, principally, if not entirely, by the dilatation of the right ventricle of the heart, and by the pressure of the atmosphere, as in the case of the venous circulation; for a direct communication is opened between the right ventricle and the thoracic duct, through the connexion of the descending cava with the jugular and sub-clavian veins, where the absorbents terminate, and where they pour their contents into the stream of venous blood, as it proceeds directly to the right ventricle. The common theories respecting the circulation of lymph and chyle are most vague and unsatisfactory, but the law here pointed out will be found competent to account for the phenomena; and where the mechanical structure is obviously fitted for the purpose, should we not rather apply a known principle, than the mere subtilties of abstract speculation?†

* Dr. Parry of Bath, the author of one of the best works on Pathology which has appeared in modern times.

† My respected and ingenious friend Mr. John Grimshaw, who is an excellent mechanician, thinks that he shall be able to construct a machine which, in particular, will show how the blood circulates, and how the lymph and chyle are absorbed upon the principles here advanced.

of secretions by the arterial capillaries is over and above the sum of the absorption by the lymphatics, and this appears to be the case in those acute, sub-acute, or chronic inflammations of the serous membranes which lead to hydrothorax or ascites; and, lastly, dropsical effusions may take place either from too super-abundant load of blood in the venous system owing to a deficiency of force in the contraction and dilatation of the heart, or from some local obstruction to the free return of the venous blood. The first two species of dropsical effusions, arising from an increased action of the heart, or from a disturbance in the capillaries of secretion, comprehend those forms of dropsy which require evacuations to be removed, the effusion being the effect of an inflammatory condition; but in the last species, the treatment requires to be more varied, for the deficiency of action in the heart may proceed from mere oppression or real exhaustion, and the local obstruction may proceed from some functional or from some organic obstruction. The circulation of the venous blood is carried on by the forcing power of the left ventricle, and by the sucking power of the right ventricle of the heart, which is also the chief if not the sole cause of the circulation in the absorbent system, so that in fact the heart is the moving power of all the fluids which circulate in the body. That the forcing power of the heart extends from the arterial to the venous system appears to me quite obvious; for wherever the heart's action is increased, then the current of blood from a penetrated vein is increased, and where the action has been very excessive, I have known the blood come out in jets. If the forcing power of the heart extended thus far, why it may be asked do not the capillary arteries pulsate, since what is called the pulse is merely the stroke of the heart! That the capillary arteries do not *evidently* pulsate is granted, but the admission is nothing against the main argument. The stroke of the heart in the larger arteries which pulsate operates upon a quantity of fluid tangible by our senses; but the stroke of the heart is so infinitely divided in the capillaries as not to be tangible by any of our senses. If I were to throw a drachm weight against any one with a given force, its impulse would be felt distinctly; but if that drachm were divided into ten thousand

parts, and if any of those parts could be thrown with the same force, its impulse would not be perceptible; and a similar mode of reasoning might be applied to the stroke of the heart as compared in the larger and in the capillary arteries. Yet it seems to me, that the forcing power of the heart would alone be incompetent to carry on the circulation of venous blood, and as some moving point would still be wanting for the circulation of lymph and chyle, the dilatation of the right ventricle is admirably calculated, on the admitted principles of mechanics, powerfully to assist the venous circulation; and in fact wherever we find evidences of a defective dilatation of the heart, there we find accumulations of blood in the venous system, and sometimes signs of an interrupted flow of lymph, as in the enlarged glands of the absorbent system, with an effusion of fluid into the cellular tissue. But if the dilatation of the right ventricle of the heart be the cause of the circulation of venous blood as well as of lymph and chyle, how could the blood and these two fluids rise when the cava descendens and the thoracic duct are tied, so as to cut off all communication with the heart? For the sake of argument, this, an experiment which has been made, shall be admitted as a fact to the fullest extent, and yet it affords no valid objection. It is a law, that a thing once put in motion would go on for ever if every impediment were removed, such as the resistance of surrounding bodies, friction, and the like. It was upon this principle Sir Isaac Newton supposed, that the tides would continue to ebb and flow for some time afterwards, if the moon and the sun were annihilated; and indeed we have a familiar example of the continuance of motion when the first cause had ceased to operate, in the current continuing to flow at the distance of some miles up, while at the same moment it is ebbing at the mouth of the river. The full elucidation however of the above opinions respecting the heart's action would lead me into too long a digression; and I have only alluded to them in order to show that some recent authors have simplified the pathology of dropsy too far; but perhaps at a future opportunity I may resume the subject in all its bearing, at considerable length, for I am certain, that a more

minute attention to the venous and lymphatic circulation would open out many new and interesting views both in regard to physiology and pathology.*

Under its ordinary characters, apoplexy may be regarded as closely allied to those examples of the common continued fever in which the brain is so implicated as to lead to the secondary affection denominated hydrocephalus internus; for in truth apoplexy is only more acute in its nature, and either depends upon venous congestion in which the heart's action is oppressed and the heat irregular, or upon arterial fulness in which the heart's action and the heat are increased. It ought therefore usually to be considered as a variety of febrile disease, the rapid progress of which prevents the common series of symptoms, when it is highly congestive in the one case, or highly excitive in the other; though there are most frequently distinct signs of cerebral disturbance, before that decided and overwhelming shock which nosologists have erroneously set down as the sole indication of apoplexy. That form dependant upon venous congestion is usually ushered in by a degree of chilliness, attended with a pale face, oppressed pulse, general agitation, deep uneasiness in the head, sickness of the stomach, and great loss of muscular power. Again that form dependant upon arterial fulness, is usually ushered in by fulness, and flushing of the face, glaryness or redness of the eyes, strong bounding pulse, and a hot skin, while the patient is apt to complain of tightness about the throat, and nearly always has deep pain and throbbing in the head, with feebleness of the lower extremities. The apoplexy of venous congestion may arise in spare and lax as well as in gross and plethoric habits, from cold applied to the surface, from too full a meal of indigestible food, from hepatic obstructions, or from some pernicious ingredient having been taken into the stomach. Occasionally I have seen it follow immersion in the cold bath in old or debilitated subjects; and I have

* If the foregoing doctrine be correct, it necessarily follows that the veins absorb, an ancient opinion which some recent experiments have rendered almost certain.

reason to believe, that those persons are attacked with this disease who sink in the act of swimming from what is called the cramp. Several instances have come under my care which proceeded from irregularities of diet, and some of them occurred in children, who had been allowed to eat too much fruit with the rind or husks. The apoplexy of arterial fulness may be induced by any cause which impels the blood towards the brain by inordinately exciting the heart; such as strong mental emotions, stimulating drinks or diets, insolation, excessive heat or exercise, or intense study; but it sometimes happens that this species immediately arises out of the former, the appearances of venous congestion giving place to an impetuous excitement of the heart and arteries. Indeed most of those cases of the common continued fever in which the cold stage is followed by a hot stage, and that again by a gradual oppression of the brain at last amounting to coma, might often be justly denominated protracted examples of apoplexy. But we have so multiplied names in our systems of nosology, as frequently to have lost sight of those natural gradations of symptoms, which mark synocha, synochus, phrenitis, hydrocephalus internus, and apoplexy when simply acute,* to be modifications of the same morbid conditions of the circulation, requiring to be treated on similar principles, as the signs of venous congestion, or of arterial excitement may prevail (36).

If a considerable number of persons were to sicken after an exposure to a bleak variable atmosphere, or to any other cause which produced chilliness first, the various gradations of venous congestion and of arterial fulness in the brain might

* Apoplexy sometimes supervenes chronic diseases of the brain, as enteritis sometimes supervenes chronic diseases of the abdomen; and the symptoms which insidiously precede this kind of apoplexy and similar affections of the brain form a very interesting subject of inquiry.

(36) Will not the reader in perusing the present and succeeding paragraphs again recognise the views entertained by Dr. Rush, on the subject under discussion. He considered all the phlegmasiæ to be merely "states of one fever" directed to particular organs by previous disturbance and predisposition. Can the coincidence of the views of the author be merely accidental?

be traced among them; but though the brain would be similarly affected in several where the febrile re-action was developed, yet in others topical disease would be seated in the chest or abdomen, sometimes with, and sometimes without an affection of the brain. In all those examples where re-action was thus developed with local disturbances, the disease might be pathologically considered essentially the same, the general excitement termed fever, and the topical disorder termed inflammation being their true and declared pathognomonic signs. Nosologists however have thought differently, and under an order denominated phlegmasiæ, we have many topical disorders arranged, one by one, according to the organ inflamed, while the inflammation of that organ is assumed to be the cause of the fever, which has therefore been called symptomatic. Let us examine this opinion, in order to ascertain when inflammation stands in the relation of a cause, and when of an effect to fever; and this is really the more necessary at present because many ingenious men, overlooking the primary phenomena, have mostly reasoned from symptoms merely consecutive in the series of accession.

What we generally understand by the term fever, is an increase in the action of the heart, accompanied with an evident increase of the animal heat. Now this state may be induced in three ways, namely, first by some general shock occasioning internal accumulations of venous blood, which in their turn rouse the heart into increased action, and finally augment the heat; secondly by some local disturbance or irritation, which, from that known but inexplicable connexion between the nervous and vascular systems, operates on the heart, and thereby increases its action and the animal heat also; and lastly, fever may be induced by some stimulus which at once, from its impression on the nervous system and thence on the heart, raises the pulse and the temperature to an unnatural height.

Most of the fevers of this, and of other climates like our own, arise from some general shock, which first occasions venous congestion, and that again the arterial excitement which follows. All contagions, marsh effluvia, and the vicis-

situdes of the weather, mostly act in this way. Hence the first symptoms are a diminution in the action of the heart, and a diminution of the animal heat, or what we call the cold stage ; now inflammation does not and cannot exist in this stage, all the phenomena of which are directly opposed to inflammation. Whenever this stage occurs, therefore, inflammation is not and cannot be a cause of the fever—in a word, it is the effect of a subsequent condition now to be noticed. The cold stage could not continue without the destruction of the body, and the hot stage is its natural cure. In the cold stage, the blood has retired from the superficial into the deeper seated veins, and from these again into the grand venous reservoirs of the interior ; so that it is especially accumulated about the right side of the heart and its larger vessels, by which its return is impeded, less or more, from all parts of the body. This preternatural accumulation of venous blood disturbs the heart, which is also further oppressed by the deficiency of one of its natural stimulants, one of those powers which keeps it in motion—the animal heat. But as the blood is also a natural excitant of the heart, it generally stimulates that organ into increased action, and hence the hot stage is brought about, that stage in which the fever has a character of simple excitement, or is combined with topical inflammation. In a fever of simple excitement the blood is so equably distributed throughout the arterial system, that it cannot be strictly said to be super-abundantly accumulated in any part ; but in a fever of inflammation, into which that of excitement is liable to pass, the blood is so super-abundantly accumulated in some part as to destroy the balance of the circulation, and materially to disturb the functions of the part thus specially affected. In what have been denominated idiopathic fevers, it often happens that for some time no organ is decidedly inflamed, a circumstance which has probably given rise to their appellation ; but in their course some organ is often so insidiously implicated, from the maintenance of the increased action of the heart, that the topical disorder is obscured by the diminution of the general sensibility. In other instances where a cold stage has preceded, the topical inflammation appears very early after the increase of the heart's action, and then it is so prominent a symptom as to have been mistaken by nosologists as the cause of the fever, though it is as truly an effect, in such examples, as any other concomitant of the hot stage ; and the seat of that inflammation will be found to be varied either according to some peculiarity in the exciting causes by which certain parts suffer more than the rest, or by the local and latent weaknesses in the subjects attacked, by which the circulation of the brain is disturbed in one, and that of the lungs in another, and so forth, as already intimated. In the cold, in the primary stage of such affections, when the reduction of the animal heat and the feebleness of the pulse are the characteristic signs, there is sometimes no topical pain, but in other instances it does exist ; and that pain is then the result of those venous congestions which are dependant upon the diminution of the heart's action and of the animal heat, and which are combined with a state of the constitution directly opposite to that existing in the disturbance of the arteries known by the name of inflammation. On many occasions, we know from the nature of the exciting cause what parts will suffer, as the throat in the scarlet fever, and the mucous membrane of the nose in the measles, and besides such topical disorders, contagions have a peculiar influence on the whole nervous system, probably from the changes which they induce in the blood. In general, however, we can trace the topical affections to previous weaknesses of the patients, which though they had not amounted to disorders when the circulation flowed with its natural calmness, yet became so when the circulation was agitated, from the blood being there most interrupted in its course. Hence it is that certain habits predispose certain organs to disease, as spirituous potations the stomach and liver, intense study the brain, bad water the bowels, and so on ; and hence, too, the influence of hereditary peculiarities of structure, and the liability of organs to a return of the same disease under which they had formerly laboured. The idea which we have of a cause is, that it is an antecedent, and of an effect, that it is a subsequent ; and