ON THE
PRODUCTS
OF
ACUTE INFLAMMATION.

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IN John Hunter's excellent work on inflammation, we find some opinions respecting the nature of the substances produced by this process, and the conclusions which that indefatigable author formed, as far as they extended, were, I believe, nearly correct, although the products actually deposited were not made the subject of direct experiment.

Considerable ambiguity has existed respecting the nature of these animal substances, from the various appellations which have, from time to time, been given to them. Thus, that which is commonly known by the name of "coagulable lymph," has been sometimes mistaken for coagulated albumen. The term "coagulable lymph," as applied to what we now understand by fibrin, is evidently a very

improper one; for the word lymph, taken singly, has, I believe, been used to express the albuminous part of the blood, and this is very well known to be coagulable; coagulated albumen, therefore, and coagulable lymph might be readily mistaken for each other, although these substances differ considerably in some of their properties. Lymph is also the name of the fluid which is contained in the absorbent or lymphatic vessels, and this is likewise said to be coagulable, although not spontaneously, as is the case with fibrin.

I shall endeavour to prove that it is this latter substance, or fibrin, which is deposited, in conjunction with serum, during the progress of the adhesive inflammation. Chemistry does not yet afford any *certain* means of distinguishing fibrin from albumen, in its solid state; it consequently becomes necessary to have recourse to its physical properties. From one of these properties the name of fibrin is derived, viz. its always exhibiting a fibrous or filamentous texture; a property which albumen cannot be made to assume, although it be rendered solid by heat, acids, alcohol, or the galvanic fluid, &c. Albumen, again, when coagulated into a mass, is very readily broken down between the fingers into a pulpy form; fibrin, on the contrary, will resist considerable pressure, being firm and elastic. But the principal distinction between these animal products, consists in the fibrin becoming solid spontaneously, when taken from the living vessels, whereas albumen has not this property.

When adhesive inflammation is taking place, the fibrin of the blood, together with serum, seem to be secreted from the vessels: they are both thrown out in the fluid state; but the former has the property of becoming solid soon after it is removed from the influence of those vessels; and in so doing it encloses between its fibres the serum, with which it had been secreted. This change begins to take place very soon after its escape from the circulating system, and does not appear to cease, till a considerable time after it has been removed from the body.

If a blister be applied to the surface of the skin, so as to produce much inflammation, it will occasion a greater or less quantity of adhesive matter to be secreted under it; this will be generally found at the most depending part, clearly proving that it had been thrown out in the fluid form, and had arrived at this situation by its gravitation. Here it gradually assumes the solid state, and during this change it retains between its fibres, (which appear to be flattened and extended) the serum, which is poured out at the same time; and it not unfrequently happens that the fibrin is so abundant, that the whole of the serum is enclosed in it, and that they form together, one solid and opaque mass. If, however, the quantity of fibrin is but small, the solid mass so produced, will be semitransparent, and have a gelatinous appearance; hence it is usually denominated a "gelly blister."

If the solid compound just alluded to be re-

moved from the body, and pressed *strongly* in a fine linen cloth, the serum will be forced out, while the fibrous part remains ; this fibrin I have chemically examined and compared with that of the blood, and could not find the slightest difference between them. The serum, so separated, will often contain a small portion of fibrin, which after a time will contract, and again render it of a gelatinous consistence. A substance of a gelatinous appearance is occasionally found about the external layers of the fibrin, in the aneurismal sac, which is probably formed in the same manner.

The solid substance, thrown out in consequence of the application of a blister, bears a great resemblance to the buffy coat of inflamed blood, the nature of which seems not to have been well understood. M. Deyeux supposed it to be fibrin, altered in its nature, so as to approach to that of gelatin. Fourcroy says, " I do not consider it as demonstrated, that the buffy coat proceeds from fibrin ; it appears to me more natural to consider it as coagulated albumen, which carries with it a portion of fibrin, on account of its concompressible power."

Again, Dr. Thomson in his work on inflammation, observes, " that the buffy coat was boiled in water, but no solution of it took place ; an event which must have happened, had it consisted of gelatine ; it exhibited no properties, different from those of the ordinary lymph of the blood."

From the results of some experiments on the buffy coat which were made with a view to ascertain its composition, I am induced to differ in some measure from the opinions of the authors just quoted. The following was one method which I had recourse to, in which I endeavoured to avoid the use of chemical re-agents, as they have been supposed, in such cases, to afford only equivocal results:—Eight ounces of blood were taken from a man who was labouring under rheumatism, and received into two four-ounce vessels; the one being allowed to rest, in order that a buffy-coat might form; while the blood in the other was kept in motion, to prevent its formation. After the lapse of twenty-four hours, the blood that had been kept agitated was washed, in order to separate the fibrin, which, when dried, weighed 12 grains*. The four ounces contained in the other vessel, being washed, and the fibrin collected and dried by the same means (having, however, the buff previously removed), afforded only six grains; consequently, it might reasonably be supposed that the six grains wanting were existing, in some form or other, in the buffy crust. This was found to be the case; for, when it was submitted to pressure, a large quantity of fluid escaped; the mass became evidently of a fibrous structure; and, when dried, it weighed precisely six grains, making, together with the six which were obtained from the crassamentum

* The proportion of fibrin varies very considerably in the blood of different individuals, and in the same person at different times.

of this blood, a number equivalent to that produced by the blood in the other vessel. The fluid thus pressed from the buff became solid by the application of heat, and consisted of common serum.

From this, as well as from other experiments, it appears that the inflammatory crust or coat of blood is not altered fibrin, as M. Deyeux thought it to be; neither is it coagulated albumen, as supposed by Fourcroy; nor does it consist entirely of coagulable lymph, as Dr. Thomson seemed inclined to consider it; but it is composed of a tissue of fibrin, containing between its fibres a very large proportion of fluid serum.

A red globule of blood is known to be formed of a smaller globule enveloped in a vesicle of colouring matter, which can be readily removed by water. The particle which thus remains is precisely of the same size as those of pus, and possesses properties so analogous, that I believe some physiologists have considered them as identical. If this be really the fact, the phenomena of common acute inflammation, when it attacks a part which is not glandular, may be very readily explained.

The modern improvements of the microscope, together with the invention of the micrometer, have afforded us an opportunity of measuring minute objects with accuracy; and Sir Everard Home has found that the particles of albumen, fibrin, pus,

and the red globules, differ considerably with regard to their relative magnitudes*. Now, as these substances, when mixed with certain salts and a considerable proportion of water, form the blood, and as they are secreted in the order enumerated when inflammation is taking place, it may be conjectured that the deposition of each chiefly depends upon the diameter of the blood-vessel from which it is poured out. When inflammation takes place, accompanied with effusion, the substance that first escapes is serum; if the inflammatory action gradually increase, and, at the same time, the diameters of the vessels be enlarged, this is followed by fibrin, the nucleus of the red globule, or pus, and, lastly, by blood in an unaltered state, as is seen in the formation of a common abscess. We also find, that when this action is commencing, or exists only in a slight degree, serum alone is effused, as is well seen in hydrocele; but when this fluid is drawn off, and an irritating one injected, the inflammation increases, the vessels become still more enlarged, and serum, together with fibrin, is effused. When a blister is applied to the surface of the body, it irritates and causes inflammation; which, if slight, is accompanied only by a discharge of serum; if it be severe, adhesive matter will be thrown out; and if the inflammation be still more violent, a puriform effusion will take place.

These observations appear to be confirmed, in

* Philosophical Transactions for 1818.

some measure, by the following circumstances. When inflammation attacks a part, the vessels of which are naturally of large size, it soon goes on to the formation of matter, if not checked by proper remedies ; but, on the other hand, if the vessels be very small in the healthy state, they seldom have the diameters so much increased as to allow of the passage of the particles of pus ; consequently, when inflammation takes place in such vessels, it usually terminates in the effusion of serum, or of adhesive matter. When serous membranes become inflamed, the common products are secreted, which would seem to indicate that these parts do not possess a glandular structure ; the blood-vessels, however, being naturally small, the inflammation seldom extends beyond that which terminates in adhesion.

I have used the term serum for one of the products of inflammation for the sake of simplicity ; but the constituents of it vary considerably in their proportions to each other ; for when it is produced by greatly increased action, it will contain a greater quantity of albumen than when that action is not so violent. This is exemplified in cases of serous effusions ; in which we find that the proportional quantity of albumen differs according to the degree of inflammation present.