

ORIGINAL COMMUNICATIONS.

NOTES ON EPIDEMICAL DISEASES.

By WILLIAM ADDISON, M.D., F.R.S.

NO. V.

INFLUENZA, CHOLERA, CONTINUED FEVER, TYPHUS, AGUE, REMITTENT FEVER, DIARRHŒA, DYSENTERY, SMALL-POX, SCARLET FEVER, MEASLES, HOOPING-COUGH.

V. INFLAMMATION.

In epidemical diseases, inflammation is usually present in some part of the body. In eruptive fevers, it is visible on the skin; and in continued fever, dysentery, influenza, etc., there is generally evidence of some degree of inflammation.

Inflammation arises in joints from local injury, a sprain, or contusion. It may arise in the same places from gout. Inflammation follows from injury inflicted on the skin, hot water, a blister, or mustard plaster. It appears in the same part in measles, scarlet fever, and erysipelas. Pustules arise in the skin from local irritants; also, in the same part, from the poison of small-pox. What are the relations of these varieties of inflammation? and what is the natural history of the process?

In the following sketch of inflammation, conclusions derived from original investigations are stated affirmatively. The facts and experiments upon which the conclusions are grounded have been published at different periods; a short account of them will here be given, and full references stated, for those readers who may require their details at greater length.

1. *Inflammation is a preliminary of repair.* Man, placed in the world, is liable to wounds, contusions, and fractures; and properties inherent in the animal economy have been provided for their reparation. Broken bones, torn tendons, and other parts separated by wounds and lacerations, reunite and heal.

In these, and in all other instances of injury or irritation from injurious agents, a degree of inflammation arises; the blood-vessels of the part are more than usually injected with blood, and there is some effusion or swelling, with heat and pain. The simplest example of inflammation follows the short application of a mustard plaster. The part becomes red, hot, and painful; but effusion is scarcely to be noticed. Upon the application of a common blister, appearances are somewhat different: there is pain and effusion, causing the cuticle to rise, but the redness is less. When an ankle or wrist has been sprained, inflammation arises; there is pain, heat, and swelling; but, as the inflammation is seated internally, in parts around the joint, redness cannot be seen. In fractured bones, ruptured tendons, and lacerations of all kinds, phenomena of inflammation occur. Lastly, in all accidents, the pain immediately following denotes the injury inflicted upon the part; but that which continues, or arises afterwards with heat and swelling, is a sign of inflammation. It is admitted by all surgical writers, that some degree of inflammation is present in all examples of repair of serious injury: and the proposition, that inflammation is a preliminary of repair of injury to the solid textures of the body, may be considered as established.

II. *Inflammation alters the structure of blood-vessels, permits effusion of lymph, and allows the blood itself an outlet into new vessels, sustaining new forms of growth.* In natural or original growth, that, for example, of a bone, tendon, blood-vessel, or any other fibrous texture, preliminary stages are observed. The part is first extremely soft, then firmer, and then fibrous, tendinous, or osseous. If any animal tissue be observed at a very early stage of growth, through a microscope, it is found composed of cells loosely cohering. The blood-vessels have the same character; they are extremely tender, and cannot be handled without rupture. As growth advances, the cells are found cohering more firmly, forming a species of cellular texture. At still more advanced periods, this cellular tissue is replaced by

one fibrous, tendinous, and elastic.* Analogously, it has been found, by examination at various periods after the accident, that fractured bones, ruptured tendons, and lacerated wounds, do not unite end to end at once; but that, in all such cases, union is brought about by a preliminary soft growth, which follows the course of original growth: and much evidence has been accumulated by microscopical observers, to the effect, that injured textures are disposed or prepared for new growth by inflammation. The summary of the evidence upon this point may be expressed as follows.

Injuries and accidents after birth must happen to parts which are advanced in, or have completed, natural growth. A new growth is demanded for repair which requires new blood-vessels. And new blood-vessels cannot arise in parts complete in growth, without a previous change in their forms and qualities. It is a necessary preliminary of repair, that established blood-vessels assume the disposition and properties favourable to the offset of new vessels; for, without these, new growths cannot be maintained. And it is unquestionably the tendency and effect of inflammation to bring parts around an injury to the condition of an anterior form of growth. Blood-vessels and connective tissue recede, until their properties and structure are coincident with those of early growth; whereupon opportunity is afforded for new vessels and new cell-structure, replete with the energies of growth to arise.†

CASE I. *Purulent Ophthalmia.* The eyelids were swollen and closed. Upon separating them, a thick white matter (pus) escaped. The cornea was clear and bright, but surrounded by and almost buried in a red, highly vascular texture, composed of granulations, having a fleshy appearance. A small portion of this was snipped off; and, on submitting it to microscopical examination, the walls or coats of the blood-vessels were found quite altered in structure, greatly thickened, and composed chiefly of colourless cells.‡

CASE II. A man died of consumption and pleurisy. On opening the chest, the pleura was found covered with a clear gelatinous matter, traversed by wavy bands of fibres and new blood-vessels. The size, number, and arrangement of these vessels, bore no resemblance to those of the normal texture. In one place, fifteen large vessels were noted, running, within a very short distance of each other, a parallel course for an inch—a thing never seen in the healthy structure. With the microscope, multitudes of cells were seen in the walls of the vessels, and the smaller branches appeared no more than simple channels in the gelatinous material.§

Inflammation, then, loosens the coherence of existing blood-vessels, cells appearing in their walls; upon which, the colourless elements or lymph of blood first, and afterwards the blood itself, finds outlets into new channels, organising and sustaining new textures. These ends accomplished, if the process be connected with repair, inflammatory action ceases naturally, just as original growth ceases. And from this point, from the newly formed texture (the granulation texture), as a basis, a series of transformations in the natural order arise for cure,—fibrous, tendinous, or osseous, respectively, as may be required for the restoration of the injured structure.||

* Vide "Healthy and Diseased Structure" (pp. 24, 31, and 33; also, p. 43, etc., plate I, fig. 5, and plate III, fig. 6), where the early state of blood-vessels in the human embryo; and those of fetal membranes, are described and figured. Vide, too, a paper "On Vascular Tissue, or the Containing Texture of the Blood" (*Medical Gazette*, July 1850), where the first state of blood-vessels in the incubated egg is described and figured. In natural growth the blood-vessels are first corpuscular and then fibrous.

† Plate I, figs. 7, 8. The natural structure of a blood-vessel in the tunica conjunctiva of the eye, and the change produced by inflammation.—Fig. 7. The vessel simply fibrous, in its natural state.—Fig. 8. Its coats thickly studded with colourless cells during inflammation. The fibrous elements of a blood-vessel becoming more and more interspersed with cells, is a phenomenon common to inflammation and scrofulous disease.—Vide text, pp. 285 to 288.—From Explanation of the Plates in "Healthy and Diseased Structure", etc., 1849.

‡ Vide "Healthy and Diseased Structure", p. 67, plate III, fig. 8.

§ Vide *ibid.*, p. 54; also the cases II, III, IV, detailed, pp. 58, 60, 62, etc.

|| "Healthy and Diseased Structure", Part I, sect. 2, and Part II, sect. 2, "On the reciprocal action between the Blood and the Textures", p. 40, etc.; "Inflammation", p. 64; also, paper, "On the Containing Texture of the Blood". During inflammation, the structure of blood-vessels alters from fibrous to corpuscular.

That these changes of form, structure, and properties of blood-vessels—this yielding of established texture to a new organisation and retrograde order of growth—does violence to the parts themselves, and to the system generally, seems proved by the pain, heat, feverishness, and excitement, which are attendants of the process. But, when for repair no further yielding is demanded, inflammation ceases, and symptoms decline: and subsequent transformations taking the course of natural growth, all remaining signs of the adverse or reverse changes incidental to the preliminary or inflammatory period disappear, superfluous elements being absorbed or removed.*

III. *There are analogies between the elements of some of the fixed organs of the body and those of blood: and inflammation is preliminary of repair of injury inflicted on the blood.* The liver is composed of organised cells, and the fluid peculiar to them is the bile. Blood is composed of organised cells, and the fluid peculiar to them, that in which they swim, is the lymph or liquor sanguinis. The cells of the liver are fixed, and constitute a great organ of the body. The cells of blood are in circulation. But this physical or mechanical difference does not vary or diminish the vital properties of the elements, either of the liver or the blood. And the one is not more liable to injury than the other. The blood itself, therefore, may be injured. In accidents and wounds, injury is inflicted on the solid textures of the body; but the properties by which inflammation is established and carried on are in the blood. Blood-vessels extend throughout the whole body, therefore inflammation and its consequences may arise in any part of it. The common expressions—impure, deteriorated, contaminated, vitiated, impoverished, and poisoned—as applied to blood, include the idea of injury sustained by it, either wholly or in some of its parts. Blood is injured by the inhalation of chloroform, by improper substances taken into the stomach, and by noxious effluvia inhaled by the lungs, impure air, and epidemic miasms. It is injured by poisonous matter, absorbed by the abraded surface of a wound, and by suppression of the natural excretions. What are the phenomena of cure in such cases? That they are various and often complicated there can be no doubt. Blood is so intimately connected with all the secreting organs and outlets of the body, that it is often freed from injurious materials by their means. There is abundant evidence establishing this mode of relief or cure by increased exhalation and secretion. But leaving for the present this part of the subject, it remains to show that inflammation is a preliminary of repair of injury to the blood.

A paroxysm of *gout* is preceded by signs of disturbed health, which arise from the circulation of blood vitiated or injured by incongruous material mingled with it. The paroxysm consists of inflammation, usually in some joint, making its onset with great vehemence. By this, the blood vessels are disposed to allow the fluid elements of the circulation a passage outwardly, and the hurtful matter leaves the blood and is deposited in the inflamed part. In *small-pox* a poison is introduced into the blood, which multiplies itself, causing injury. What is the consequence? Inflammation arises at various points upon the skin. The inflamed vessels lose their coherence, permitting a discharge of the poisonous matter. And when this has been thrown out from the circulation, inflammation and illness subside together. Poisonous material, from various sources, sometimes accidentally gains access to the blood, through an abrasion in the skin. Whereupon, fever sets in, and there is inflammation not only in the wound, but in one or more distant parts of the body. The inflamed vessels furnish the required outlet to noxious matter; for, with the formation of abscess, and discharge of its contents, the symptoms of illness disappear. "Let us ask", says Sydenham, "what is the nature of plague? Is it aught else than a complication of symptoms, which nature puts in play, in order that through natural eliminations either in the way of abscesses or by the help of some other form of eruption, she may expel from the body

those infectious particles that we have taken in along with the air that we breathe? And what is gout? It is a provision of nature to purify the blood of old men, and to purge the deep parts of the body. Such, at least, is the language of Hippocrates."

Blood, then, is injured by infectious and gouty particles; and inflammation, eruption, pustules and abscess are preliminaries or conditions of its repair or cure.

IV. *Inflammation is destructive to existing forms. It alters the function and uses of the parts in which it is seated. And yet it is beneficial, as establishing new growth necessary for the repair of solid textures; also as forming outlets, from the circulation, for injurious matter mingled with the blood.* Let us say a few words upon the twofold aspect of inflammation as preliminary to the repair of injury. It is, on the one hand, clearly prejudicial to the vessels and textures in which it is seated, inasmuch as it renders them extremely soft and tender; it takes away their natural properties and uses; and gives outlet to the blood, which flows in new channels. On the other hand, the previous injury has been sustained, and these yielding, changes in blood-vessels are necessary and beneficial. Because, 1. Repair of injury to the solid textures requires new growth, new growth requires new blood-vessels, and new blood-vessels cannot appear except by change of form and properties in established vessels; and 2nd. Unhealthy or incongruous matter circulating in the blood, if not thrown out by a secreting outlet, requires a yielding of established vessels for its elimination.

V. *There are two stages of inflammation, each of which is sufficient for repair.* In a sprained joint the parts have been severely stretched or twisted. Inflammation and swelling arise; that is to say, there is hyperæmia and effusion of lymph. The effusion forms the proof that the tone of the inflamed vessels has so far yielded, as to afford to the fluid elements of blood an outlet through their walls. But as, in this example, there is no rupture of large tendons, ligaments, or bones, so there is no display of new growth demanded for repair. The stages and influence of inflammation are therefore limited. The coherence of the inflamed vessels yields only to the extent of effusion of lymph. And this done, what is necessary seems accomplished, for the vessels without further change recover their normal tone or constitution; whereupon elements of blood no longer pass outwards; on the contrary, the tendency is now inwards, and what has been effused, is absorbed as the swelling subsides. On the other hand, in more serious injuries, fractures, burns, and lacerations, new growth is demanded for repair, and inflammation follows ulterior courses. The coherence of the inflamed vessels yields not only to the extent of effusion of lymph, but further, so as to permit the blood itself, cells and all, to issue forth in new channels, organising new growth. Thus, by extent of injury, and requirement of repair, is established two varieties of inflammation. The one, which may be called the first variety, is limited to hyperæmia and so much change of structure as allows of effusion of lymph; in the other, or second variety, the changes extend to the formation of new vessels sustaining new growth.

So likewise, from the phenomena, it would appear that lighter injuries to the blood are relieved by the first stage or variety of inflammation,—such are *gout*, *rheumatism*, *measles*, and *erysipelas* and *scarlet fever* in their mild forms. But that graver injury demands the ulterior changes, and *pus*, which is a form of new growth, appears in *plague*, *traumatic fever*, *small pox*, and the severer forms of *scarlet fever* and *erysipelas*. In all the circumstances relating to life there is a middle term, and it is that only which is co-ordinated with benefits or health. Too much and too little food is hurtful; too much warmth is heat occasioning burns and scalds; too little is cold producing chilblains and mortification. Health is in the middle,—a yielding of structure at either extreme; so it is with respect to inflammation itself. When injury has been sustained, a certain amount of yielding in vascular tissue subserves the purposes of cure and repair; but from this required amount, a deviation on either side is disease. It has been shewn, that every part of the human body passes through progressive phases of

* "Healthy and Diseased Structure", p. 236, etc.

growth, and that every phase of growth has its forms of disease. (Notes, No. iv, p. 169.) And if in natural or original growth we find monstrosities and defects—arrests of development and excesses—exuberance and deficiency; so, *a fortiori*, analogous deviations may be expected in preternatural inflammatory growth. "If injured textures are repaired and wounds heal, *inflammation is healthy*; if granulations persist and will not heal, *inflammation is unhealthy*; and if normal textures continue to yield, giving way to inflammatory growths, *scrofulous disease is established*."*

The general conclusion which arises from the establishment of the foregoing propositions, may be expressed as follows.

Vascular tissue, upon injury or irritation, recedes from its established or completed form to some anterior type of growth. Blood vessels yield in structure; upon which follow effusion of lymph, and the formation of new vessels sustaining new growth. To this phenomenon the term inflammation is applied. The products or results are extremely various: repair of injury, elimination of morbid matter from the blood, pustules, abscess, ulceration, and scrofulous diseases.

"As to what may be the *essence* of small pox, I am, for my own part, free to confess that I am wholly ignorant. Nevertheless, when I carefully weigh the evidence of the symptoms, it suggests to me the idea of inflammation. In clearing herself of this, nature is at work during the first two or three days, striving at the digestion and concoction† of the inflamed particles, with the intention of afterwards discharging them upon the surface of the body, for the sake of maturation, and finally of expelling them from her boundaries under the form of little abscesses.

"We must, then, if we wish to make our *methodus mendi* the superstructure to a foundation in principles, recognise two periods in this disease: first, the period of separation; secondly, the period of expulsion.

"The first of these two periods is generally passed in a febrile ebullition, which usually is completed within the first three or four days. *During this stage nature is employed upon picking out and gathering together those inflamed elements which fret the blood, in making them over to the fleshy parts of the body, and in depositing them therein.* This being accomplished, she returns to her former repose, having allayed the tumult which was excited during her operations in the blood.

"When the ebullition has thus brought about the separation, the process of expulsion begins, and this continues during the remainder of the disease, by means of the little abscesses in the solid parts. These, inasmuch as they agree with a true abscess in character, pass through all the stages, *viz.*, those of crudity, maturation, and exarescence. If all this is done properly matters are safe; upon its being done properly, however, all chance of cure depends; everything goes wrong when this is faulty."‡

In local injury, the person at the time is usually in health. The blood is healthy; inflammation sets in with good materials. Phenomena take the normal course; and the cause of irritation ceasing cure follows. But when the blood itself is suffering injury or disorder, inflammation commences with degraded or imperfect elements; and, therefore, the action is the more likely to exhibit irregularity in its course. When a bone has been broken, the case comprises: first, the fractured bone, with loss of use of the limb; and, secondly, the history of inflammation,—its course and transformations for cure. Analogously in epidemical disease, the illness comprises: first, the injured or contaminated blood; and, secondly, the history of some form of inflammation, eruption, pustules, abscess, or crisis, established for the discharge of the tainted particles. When a fracture occurs, we know what occasioned the in-

jury, and we can see or determine the amount of mischief,—*simple, contused, comminuted, compound, etc.*; and thus we are prepared for an easy or protracted, difficult or dangerous, process of cure. On the other hand, in epidemical diseases, we know but little, perhaps nothing, of the miasm, or of the amount of injury it has inflicted on the blood; and, therefore, there is here a very insecure ground upon which to base an anticipation of the coming lightness or gravity of the process of elimination or cure.

We have said that pus is a species of growth, and it remains in conclusion to show how this appears. Small colourless particles or cells are universally the primary elements of growth; they constitute the early forms of all animal textures and blood-vessels. Similar small colourless particles circulate at all times in the blood, and the more abundantly the earlier the period, or the greater the energy of growth. Such particles or cells accumulate in parts experiencing inflammation. They appear in the coats of the inflamed vessels, and loosen their texture, they exist in lymph, and are the prevailing elements of new growth; they also form the walls of the new vessels; and, lastly, they are extremely abundant in pus. These considerations, together with the determined manner in which pus arises and accumulates in spite of many obstacles of a physical kind, and the remarkable way in which established blood vessels recede before it, prove that *growth* is the appropriate idea to be attached to the formation of pus. A retrogression of vascular tissue or inflammation precedes alike repair, new growth, abscess, pustules, and ulceration. It is in products or results that differences arise. In growth and repair, the new matter which follows upon the retrogression enters into new forms, new blood vessels appear, and granulation structure arises. In abscess, pustules, and ulceration, it does not enter upon new forms, remaining fluid: so that when the wall of the abscess gives way it flows out as pus. In abscess and pustules, the purulent accumulation forms the prominent character; it occasions the swelling, whilst the receding changes in the surrounding vascular tissue are not so readily perceived; but in an open ulcer these constitute the prominent character, because the pus is continually discharged.*

Finally, arsenic and mercury are virulent and destructive poisons; yet no one doubts that both may be so adjusted, in quantity and appropriateness of application, as to become most valuable medicines. So, analogously of inflammation, no one doubts its destructiveness in respect of the vessels and textures in which it appears; yet still, adjusted by the hand of nature, in quantity and appropriateness, it opens the way to repair of injury to the textures of the body, and to the elimination of morbid matter circulating with the blood.

Maidstone, March 1854.

LECTURES DELIVERED AT THE LOCK HOSPITAL, LONDON.

By HENRY LEE, Esq., F.R.C.S., Surgeon to the Hospital,
No. V.

ON SYPHILISATION AS APPLIED TO MAN.

In my former lectures, I mentioned that artificial inoculation gave rise, under different circumstances, to different classes of local affections. In the first of these, the symptoms were those of the adhesive inflammation. I mentioned that, in this class, the secretion from the inoculation consisted, during the first days, of a thin fluid, which gradually became more turbid; and that the parts in the immediate neighbourhood subsequently became indurated in a very peculiar and characteristic manner. In the second,

* "Healthy and Diseased Structure", pp. 29, 30, and 70.
† "Concoction" of the matter of fever simply means the separation of the sound from the unsound. (Sydenham.)
‡ Sydenham.

* Vide the paper before referred to ("Medical Gazette", July 1850); also, "Healthy and Diseased Structure", p. 30, etc.