on the inferior margins, and on the surface of the lobes, must be taken as collateral proofs of the existence of some long-standing affection of the pulmonary organs, attended most probably by violent expiratory efforts, as in coughing; but the subject and pathological conditions of emphysema I propose to treat of on some other occasion.

THE LAW OF THE MORPHOLOGY OR METAMORPHOSIS OF THE TEXTURES OF THE HUMAN BODY.

(Fourth Series of Experimental Researches.)

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

(Continued from page 93.)

VII. THE PROCESS OF NUTRITION, OR THE RECIPROCAL ACTION BETWEEN THE BLOOD AND THE SOLID TEXTURES.

The growth and preservation of all parts of the human body, and the renewal of its textures and secretions, whether healthy or diseased, depend upon a reciprocal action between the blood and the solid parts, termed the process of nutrition, in which certain elements or forms of matter withdrawn from the circulating current, become portions of the fixed solid. If the newly withdrawn matter assume the form of the pre-existing elements of the solid, and the quality of the pre-existing secretion, the process is said to be *normal* or healthy; but if the elements of the solid be changed, or the quality of its secretion altered, in consequence of any unusual change or uncomfortable transformation which the new matter undergoes, then the process is said to be *abnormal* or unhealthy.

If the circulation of the blood be observed with the microscope, in the nutrient vessels of a transparent texture in the living animal, without any previous rude handling or irritation, the stream is seen rapid and uniform, and it is impossible, from the rapidity of the current, to discriminate its cellular or corpuscular elements, except that here and there colourless cells are seen clinging to the walls of the vessels, slowly gliding along in close contact with them. If the part under observation be irritated, the regularity of the stream is immediately disturbed in a very remarkable manner, and, as if in consequence thereof, colourless cells, in increasing numbers, are observed separating themselves from the red current, and becoming fixed to the walls of the vessels. Soon afterwards, a clear colourless material appears between the stream of red blood and the solid texture, in which the colourless cells seem to be embedded; so that the irritating cause, of whatever nature it may be, is productive of an actual and visible separation between the colourless and the red elements of the blood, which is seen to take place within the vessels, the red flowing onward, sometimes with the utmost rapidity, whilst the colourless remain stationary, and form a new interior coating

to the vessels (the protoplasma.) We are precluded from making this direct satisfactory and conclusive observation in the human body, because there is no accessible part sufficiently thin and transparent for the purpose; but we have cogent reasons in the analogies of life and function—in the composition of the textures and the blood—for concluding, that in man, analogous or similar irritants are followed by similar results. This conclusion, drawn from analogy, is substantially corroborated by the fact, that in the human body, colourless cells greatly abound in the blood drawn from vessels that are experiencing any irritative or inflammatory action.

But the real nature or meaning of the phenomenon, thus seen in the living vessels of animal structure, and presumed from strong analogies to exist in the human body also, must be interpreted by the result or product—and this clearly proves it to be a phenomenon of nutrition, for the irritated animal textures become thicker, and new layers and new matter appears;—so in the human body where textures are becoming thickened, where new products and new results are appearing,—in pimples, boils and vesications,—in the skin in scarlet fever and erysipelas,—colourless cells are exceedingly abundant in the nutrient vessels, sometimes equalling in amount the number of the red cells.

Hence, therefore, it appears, from proofs accumulated on all sides, that the separation of the colourless cells and protoplasma or lymph of blood, from the red cells, and their distribution in a stationary form over the interior surface of the nutrient vessels are phenomena of nutrition; and it would farther appear from the cellular or corpuscular nature of pus, and from the ready healing by pressure of wounds discharging pus, that if the colourless elements withdrawn from the blood fail to undergo a conformable metamorphosis, or the cells to deliver up their contents, they change the character of the walls of the vessels, alter the anatomical type of the texture, and subsequently appear in the discharges or secretions,—in which case *the whole thickness* and the whole of the matter in the walls of the vessels experience a progressive alteration from within, there being no membranous septum or *structureless membrane* under these altered conditions, standing as a barrier to the retrograde morphology.

The process of nutrition here described from observation and experiment, comprises three intelligible and visible stages:—*First*, the separation of the colourless cells and protoplasma of the blood from the red current; *secondly*, the metamorphoses of these colourless elements in their progress through the walls of the vessels; and *thirdly*, the ultimate product which constitutes the permanent form or textural type. The first stage takes place within the vessels, along their interior boundary; the second takes place in, and gives the form of, the elements of the walls of the vessels; and the third, or ultimate product, appears at the outer

margin and is in fact an extension, of the vascular wall.

These stages of nutrition will be more readily comprehended by referring to the wood engraving, which represents *one half* of the diameter of a small blood-vessel in the transparent membrane of a human embryo, at two months, that is to say, in a texture in a state of rapid growth or active metamorphosis. It was copied from the microscope, and is magnified 750 diameters

linear. The dark portion, *a*, is one half of the column of red blood lying in the centre of the vessel; the red cells are many of them nucleated, and larger than in the blood of an adult, and lying obscurely amongst them are several colourless cells—various in dimensions—some very large and filled with a colourless matter mixed with molecules. At *b* is a transparent layer of colourless matter or protoplasma, lying between the column of the red blood and the wall of the vessel;

Fig. I.—Half the diameter of a small blood-vessel in the transparent membrane of the human embryo at two months. *a*, column of red blood. *b*, layer of colourless matter, with cell, granules, and molecules, between the red blood and the coherent wall of the vessel. *c*, a texture composed of fibres, cells, and nuclei, forming the wall of the vessel. *d*, the coherent cellular texture forming the membrane.

Fig. II.—A section of the same vessel perpendicular to the axis, shewing the same series, blood, protoplasma, texture, (*αρωρον υφασμα*), and cellular parenchyma. It appears to me, that the subject of secretion, the growth of the embryo structures, and the phenomena of inflammation, would be more intelligible were we to use terms expressing more accurately the stages of nutrition, as revealed by the microscope:—*a*) blood—(*b*) protoplasma—(*c*) prot-uphasma—(*d*) parenchyma. I well remember the late Dr. George Pearson, five and twenty years ago, insisting upon the distinctions between *coagulable* and *coagulated* lymph.

in it are seen several colourless cells of various sizes, filled with molecules, also smaller granular particles; and numerous isolated molecules. At *c* is the wall or coat of the vessel, (the *prot-uphasma* or first texture,) composed of numerous colourless cells or nuclei embedded in a mass of nascent fibrils, which have, in this example, hardly more coherency than the fibrils of a tough mucus. Granular particles and molecules are seen within these colourless cells or nuclei, and the fibrils pass around and between them. Numerous red cells of irregular shape are seen mingled with the colourless elements,—cells, nuclei, and fibrils,—of the vessel's wall, or coat; but these have all the appearance of being accidental and due to the manipulation necessary to render the texture a microscopic object. At *d* is a portion of the transparent cellular membrane itself—the *parenchyma*; it is evidently an extension or expansion of the wall of the vessel, and no unalterable barrier exists to separate it from the *protoplasma*—every element is in progress of change.

If a section of this vessel were made across it, perpendicular to its axis, we should have a column of blood in the centre (*a*), consisting of red and colourless incoherent cells, suspended in the blood-fluid; next to it will be a layer of colourless lymph or protoplasma (*b*), consisting of a viscous matter, mixed with molecules and colourless cells; next to that is the proper coat of the vessel (*c*), the first texture varying with the morphology, and consisting in this case of delicate fibres, intermingled with molecules, granules, and colourless cells or nuclei; and lastly, as an extension of the vascular wall, the proper texture or parenchyma (*d*),—this texture shewing what the morphology has been, and the existing vascular wall indicating what it is or will be. A similar section of a vessel that has been irritated in the frog's foot, would exhibit the same thing. Hence, then, the conclusion stated in the, "*First Series of Researches*," p. 30, respecting the analogies between active growth and inflammation, is fully borne out by these subsequent investigations.

These things, let it be observed, are not matters of surmise and conjecture, but of demonstration, and cannot, therefore, be set aside because they do not square with received and hypothetical notions. It is very easy to throw discredit upon microscopical facts and conclusions by a flourish of the critical pen, and a flippant style of remark, little suited to the occasion; but Nature marches on, although the critics write, and is ever ready with intelligible answers to those who faithfully interrogate. A florid appeal to existing sympathies may be for a time successful. Warm-hearted spirits contend stoutly for their convictions; and settled opinions are difficult out-works to carry, though Nature herself be battering at the walls. But those who, in the ardour of their defence, merely uphold their own opinions, when truth and science are rolling

onward in new directions, must find themselves at last protecting shadows in the rear.

In bringing my observations for verification to the test of the microscope, I would fain remark, that the observer should bear in mind the minuteness and delicacy of those portions of structure that can alone be submitted to high microscopic power, and the unavoidable disturbances that necessarily ensue when it is requisite to take very thin sections, and therefore that decisions *pro* or *con* should be based not so much upon the isolated results of one or two hasty trials, but rather on the tenor of the indications derived from a greater number.

In any departure from the law of the nutrition of a texture,—from the law of the morphology,—it must be a very difficult question to determine where the first unconformable step commences, whether in the blood *a*,—in the lymph or protoplasma *b*,—in the wall of the vessel *c*,—or in the texture *d*? It is very common to read about diseases of the blood, yet all must be dark and unsatisfactory to any one that has observed the relations between the blood and the textures by means of adequate power through the microscope; and certain it is, that no practical conclusions can be established respecting health and disease until the stages of nutrition, the reciprocal actions between the blood and the solid textures, be established. At present the notorious fact of red blood, administering to the rapid increase or deposition of colourless textures, lymph, mucus, and pus, remains, in respect of any well-directed scientific investigation, a glaring instance of theory, hypothesis, and conjecture. Critical physiologists seem afraid of using their eyes, though they battle boldly with assertions.

VIII. INFLAMMATION.

When the growth and nutrition of a texture of any kind, whether animal or vegetable, is normal, its elements are reproduced or multiplied, its form evolved, and its characteristic qualities and secretions established by a metamorphosis of the nutritive elements, supplied from without, in accordance with the law originally in force in the primary conformation of the parent organism from which it sprang. Every change,—every metamorphosis,—every action,—and every product, yielding or conforming to the law, is an integral element of the complex phenomenon termed health; and every action or product deviating from it, is an element of disease.

It is not my intention now to enter upon the multiplied details of inflammation or inflammatory products; hereafter we shall have occasion to return to the subject, and examine more particularly the nature of its manifold results.

We have seen that any irritation of a vascular texture, is productive of an increased amount of nutritive matter, which is deposited from the circulating blood, upon the walls or inner boundary of the vessels.

The *increased* amount of matter so deposited is a deviation from *the law* of the texture, and therefore a phenomenon of disease; but the sensible or visible effects upon the texture depend upon the times, stages, and forms, of the subsequent morphology, which may conform to the law of the texture, or deviate from it. For example—the *fibrous textures* are not secreting textures; they do not evolve a viscid mucus mixed with cells; this is not the law of *their* nutrition. These textures are therefore on this account called *serous textures*. But there are other textures that do evolve a viscid mucus, mixed with numerous colourless cells, and these are therefore termed *mucous textures*. Now, an unusual amount of nutritive matter, deposited upon the walls of the blood-vessels of a fibrous texture, and a *conformable morphology*, necessarily give rise to an increased amount of the elements of the texture, which becomes thickened by abnormal fibres; and if adhesions are contracted between contiguous surfaces, it is by fibres; and the serous fluid which naturally lubricates the texture, is increased in quantity. On the other hand, an unusual amount of nutritive matter, deposited upon the walls of the nutrient vessels of a mucous texture, and a *conformable morphology*, give rise to an increased quantity of mucus, mixed with a larger number of colourless cells. In either case, an unconformable morphology would produce different forms and qualities—fibrous forms, for instance, upon the mucous textures, and corpuscular forms upon the fibrous textures.

"INFLAMMATION," says a recent and talented author "must needs occupy a large share of the attention both of the surgeon and the physician; it is continually the object of his treatment and watchful care. It affects all parts that are furnished with blood-vessels; and it affects different parts very variously."—"A great majority of all the diseases to which the human frame is liable, begin with inflammation or end in inflammation, or are accompanied by inflammation during some part of their course, or resemble inflammation in their symptoms. Most of the organic changes of different parts of the body recognize inflammation as their cause, or lead to it as their effect; in short, a very large share of the premature extinction of human life in general is more or less attributable to inflammation."—"Again, inflammation is highly interesting, not only in its morbid phenomena and destructive consequences, but in its healing tendencies also. It is by inflammation that wounds are closed, and fractures repaired,—that parts adhere together when their adhesion is essential to the preservation of the individual,—and that foreign and hurtful matters are conveyed safely out of the body. A cut finger, a deep sabre-wound, alike require inflammation to re-unite the divided parts. Does ulceration occur in the stomach or intestines, and threaten to penetrate through them? Inflammation will often anticipate and provide against the

danger, glue the threatened membrane to whatever surface may be next it, and so prevent that worst and universal inflammation of the peritoneum which the escape of the contents of the alimentary canal into that serous bag would infallibly occasion. Inflammation, limited in extent, and moderate in degree, becomes conservative by preventing inflammation more severe and more widely-spread, which would be fatal."*

This being the graphic picture of inflammation by a practical physician, the question very naturally arises, what *can* this inflammation be?

In the first place, the answer appears to me to be clear upon this point,—that the inflammation which is conservative,—closes wounds—repairs fractures—has healing tendencies—and preserves the life of the individual,—must be different from the inflammation which produces destructive consequences—morbid phenomena—organic changes—and prematurely extinguishes human life; and therefore, that two very different, nay, opposite and incongruous things, are brought together under the unscientific and silly term of inflammation. The difficulties of the subject obviously arise, not from an oversight of the primary phenomenon, the disturbed circulation of the blood, and the increase of nutritive matter in the vessels of the affected texture, but from an utter neglect of the physiological elements involved, and therefore, necessarily of the conformability or unconformability of the morphology. A nutritive element,—that is, an element of growth, nutrition, or secretion,—which is conformable and therefore healthy in one texture, is unconformable, and therefore an element of disease, in another and different texture. An unusual abundance of colourless corpuscles or cells and an increased mucous secretion in a mucous texture, may pass under the term inflammatory product; but mucus and mucous cells are conformable products, and an unusual amount denotes no more than an increased amount of the elements natural to the texture; whereas, the very same elements in a fibrous or serous texture or in the fluid evolved from it, are the proof of an unconformable metamorphosis, because such incoherent forms are not natural to this texture.

If so complex a subject as normal and abnormal nutrition,—of conservative and destructive inflammation—be susceptible of a short definition, it may be said, *that simple healthy inflammation consists of an increased amount of protoplasm with a conformable morphology; and destructive unhealthy inflammation, of an increased amount of protoplasm with an unconformable morphology.* The terms conformable and unconformable, referring to the law which governs and determines the physiological form and function of the texture in health, and which must be known before the nature of

* "Lectures on the Principles and Practice of Physic," (in the *Medical Gazette*), Dr. Watson.

the diseases can be understood. It is not necessary to this definition of simple healthy inflammation, that *all* the nutritive elements furnished by the blood should undergo a conformable metamorphosis; it is sufficient that they do so within a reasonable time, to the extent of restoring the irritated, wounded, or inflamed texture to its normal state and function.*

Practical medicine is based upon the recognition and appreciation of visible or sensible signs: the physician cannot treat diseases ascertainable only by the microscope; but if this instrument carries our analysis of change of texture into hitherto unknown regions, the medical practitioner must be prepared to accept or reject its testimony *in toto*. There can be no halting between the microscope and the eye,—interpreting one part of physiology and pathology by the vision of nature, and another by the improved vision of art. If the microscope is to be relied on as an analytical means, then not only is every *post-mortem* examination imperfect and the majority useless without it, but we must no longer speak of vessels or ducts secreting. Vessels convey or transmit incoherent corpuscular forms, and are the means of their accumulation; and ducts convey them away out of the body. Transformations of matter are effected, or secretions formed, within the cells.

* The phenomena of inflammation, although very multitudinous, may in fact be resolved into the morphology of the contents of individual cells, the conformability or unconformability of the product being dependent upon the normal or physiological type of the elements of the texture, and the form resulting from the last stage of the inflammatory metamorphosis. This is shewn by the phenomena of inflammation in the several textures of the lung,—pleurisy (*fibres*), bronchitis (*cells and mucus*), and pneumonia (*a mixed product*.) I would beg to suggest to Mr. Hassall the benefit he would confer on physiology and pathology, by extending his "Microscopical Anatomy," so as to include the elements of the various parenchymata, and the structure of their nutrient vessels in the embryo and in the adult, viewed with a power of 600 or 700. If these were correctly established, the phenomena of scrofulous diseases and inflammation would be rendered easy.

(To be continued.)

CASES AND NOTES FROM HOSPITAL AND PRIVATE PRACTICE.

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(Continued from page 547, of last Volume.)

CASE XVII.

CIRCUMSCRIBED EMPYEMA, COMMUNICATING WITH THE BRONCHI: ABSCESS OF THE LUNG: PHYSICAL SIGNS: TREATMENT: RECOVERY.

J. M.—, aged 27, a labourer, admitted into the Ipswich Hospital, September 3rd, 1846, under the care of my colleague, Dr. Beck, who being prevented visiting the hospital at the time, the case in part fell under my observation.

He stated, that seven weeks prior to his admission,

he was seized with rigor and pain in the right side, succeeded by slight cough, at first dry, subsequently with some expectoration. He attributed his illness to drinking a pint of very cold water from a spring, when greatly heated by hay making.

The symptoms on admission were thus noted:—Complexion muddy; tongue tolerably clean; bowels regular; urine natural; pulse 80, of good strength; cough not very urgent; expectoration muco-purulent, having a peculiarly unpleasant sickening odour.

Physical signs.—*Inspection*: Evident bulging of the antero-inferior region of the right side of the chest, from between the third and fourth ribs downwards, the affected portions rising *en masse*; vocal and tussive vibration not particularly noted.—*Percussion*: Complete dullness over the anterior and lower part of the right side in front; normal sonorosity behind; the left side healthy.—*Auscultation*: Total absence of breath-sound over the lower-third of the right lung in front; slightly exaggerated in the antero-superior region of the same side; fistulous breathing audible between the fourth and fifth ribs; respiration natural over the back; no abnormal rhonchi; resonance of voice and cough unaffected; left lung healthy.

These phenomena continued for about a week, with but little variation, the pulse remaining at 80, soft, and of moderate strength; tongue clean; appetite excellent, and bowels regular. At this period the patient became suddenly worse; he had a rigor; the skin was hot; the cough greatly increased; expectoration purulent, the odour from which was now scarcely bearable; he had nocturnal perspirations, and evidently emaciated; the pulse, however, remained steadily at 80, of fair tone, and the appetite continued tolerably good. There was occasional vomiting, which was justly attributed to the horrible fœtor of the expectoration. On examining the chest, the respiratory murmur was now feebly audible over portions of the affected region, on the right side in front, in which it had hitherto been extinct; the fistulous breathing had disappeared, and about two inches to the outer side of the right nipple, and a little above that projection, there now obtained, in addition to a modified amphoric stroke sound, cavernous breathing, loud bronchophony, and slight gurgling, clearly indicative of a pulmonary abscess. The vesicular murmur immediately around this spot was healthy.

Treatment. This consisted of counter-irritation by means of two successive blisters to the side, followed by antimonial pustulation, mercury (Hydrarg. cum Creta,) to affect the gums, the influence of which was prolonged, salines; subsequently the iodide of potassium, creosote internally, and by inhalation; and lastly, quinine and nitric acid, with the syrup of the iodide of iron. The diet, with the exception of the first few days after admission, and the period of the rigor, was "full" throughout—viz., meat daily, with a pint of porter. Under the above treatment the patient rapidly gained flesh and strength, the cough subsided, the expectoration became less, with diminished fœtor, and the progress of the case towards recovery, although slow, was uninterrupted. He was discharged perfectly well, the respirations being fairly audible