

At this period the patient began to seem less bright and the headaches came oftener. Three months ago he began to have trouble in walking, would stagger as if drunk, and several times fell while walking. His staggering was mostly toward the right. This difficulty and the mental dulness have progressively increased, and his hand has begun to tremble in writing; he now can not drive a nail as he used to do. There have been no gastric symptoms until two months ago, when vomiting began, coming unexpectedly, not preceded by nausea, and without any constant relation to the taking of food. This came once or twice a week at first, but has steadily increased in frequency since. Eye symptoms began about three weeks before he entered the hospital, his eyes growing steadily weaker so that he can no longer read. Double vision has been noticed several times in the last month, lasting a few minutes each time. During the attacks of retraction of the head, above mentioned, his eyes look glassy and unnatural. His hearing is very good, but roaring in the ears has been complained of lately. During one of the attacks of vomiting and retraction of the head, about three weeks ago, he was at times "out of his head" for most of one day, and, to his parents, seemed to be unconscious for a few minutes. During such spells he always breathes quick and hard, and gets dark in the face. No true convulsion has been seen at any time, no vertigo complained of; his appetite is good; his bowels regular; he sleeps a great deal and very heavily; has been growing fast and getting fat for the past year. His disposition is becoming irritable and faultfinding.

Physical examination.—When seen at the hospital he was a well-developed and well-nourished boy, bright looking, and with rosy cheeks; his pupils large but equal, and reacting normally. The eye-muscles moved normally; the tongue came out straight, and there was no facial asymmetry; two small glands were palpable over the right clavicle; there was a cog-wheel respiration at the top of both lungs; the thorax was negative; the muscular power was good and equal on both sides, but there was marked ataxia of the right arm, and the abdominal reflexes were less marked upon the right; knee-jerks were increased; the sensation was everywhere normal, the liver dulness reached up to the fourth interspace, the lower border not felt; the abdomen wholly negative.

He stayed a week at the hospital, taking extra diet, hypophosphites, cod-liver oil. Once during his stay, it was noticed that the head was somewhat retracted. It could be bent forward, but this hurt him. He was quite conscious and bright at the time, and the symptoms passed off in a few hours. There was occasional vomiting after meals. The staggering gait was very marked, but he managed to get about the wards. His urine was occasionally passed involuntarily, and at times he had trouble in starting the stream. The diagnosis of cerebellar tumor, probably solitary tubercle, was made by Dr. Cutler. He was seen in consultation by Dr. A. T. Cabot, who advised against operation, and thought he might improve under constitutional treatment. He left the hospital Sept. 21, 1893. Nearly five years later, May 20, 1898, he walked into my office, a picture of health. He now works on an express team and has not missed a day's work in two years. His most interesting statement is best given in his own words: "There was one thing I ought to have told you folks down to the hospital, but I didn't. I used to abuse myself a lot. After

I went out of the hospital I left it off, and just as soon as I did I began to get better. Now I am all right, except I still stagger in the dark, and my eyes are not first-rate." The vomiting and head retraction had ceased soon after he left the hospital. He has grown up into a well, strong boy. His right hand is still slightly weaker than the left, and he thinks his right leg is also weaker. His gait is nearly, if not entirely, normal. He reads small print well; examined at the eye and ear infirmary, June 2, nothing wrong was found in the fundus. A letter from him, received March 24, 1899, says that he is perfectly well and hard at work.

Can all the symptoms of this case be explained by the masturbation? Can a solitary tubercle of the cerebellum have been absorbed or encapsulated? So far as I know no autopsy has yet been reported, showing the remains of a healed solitary tubercle of the brain, but that such a thing is possible is certainly suggested by the like fate of tubercular processes elsewhere in the body.

SOME REFLECTIONS UPON CELLULAR PHYSIOLOGY AND PATHOLOGY.*

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Modern research and investigation have shed much light on the intimate nature of disease processes, but there is a good deal of virgin soil yet to be tilled. Life may be looked upon as a manifestation of the activity of the cell (or of an aggregation of cells), which, if expended in a proper manner, represents the condition of health. Perversion of this activity, through influences acting from either within or without, leads to disease; while permanent inhibition (destruction) results in death. Normal cellular activity (function) implies a proper relation between waste (catabolism) and repair (anabolism), the replacement of used-up and worn-out material by fresh nutritive pabulum, together with the elimination of the products of disintegration—normal metabolic or nutritional equilibrium. Failure in either of these processes, as well as defect in quality of the nutritive pabulum, gives rise to derangement of this metabolic equilibrium, resulting in the one instance in inanition, in the other in intoxication. The latter, besides being intrinsic, may also be extrinsic. In any event the derangement of nutrition is attended with alteration of function, which, however brought about, adds in turn to the nutritive disturbance. Cells differ among themselves in their activity and reactivity, in their affinities and antagonisms, in their susceptibilities and resistances, in accordance with qualities, properties and attributes either derived from parent cells (heredity) or acquired through the influence of environment or other extraneous factor.

Disease may thus be viewed as primarily the expression of a perversion of nutrition, with derangement of function, and also with alteration in structure. The nutritive perversion may arise from changes taking place within the body, or result from the operation of agencies introduced from without. Thus, nutritive disturbance and functional derangement may result, on the one hand, from failure in the elimina-

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tion of waste products of metabolic activity generated in ordinary amount, or the retention of such products in consequence of their generation in excess (auto-intoxication); or, on the other hand, from the action of poisons that gain entrance into the body in various ways (heterointoxication). Disease may be caused besides by certain physical agencies of extraneous origin, such as violence, extreme heat or cold; and as a result of the invasion of micro-organisms (infection) and the unfolding of their activity (intoxication). Physical agencies give rise to disease directly by reason of their destructive effects, and indirectly by rendering favorable the conditions for infection and bacterial activity. Destruction of tissue means loss of function and deranged metabolism, and altered nutritive conditions. Bacteria act in part as foreign bodies, in part as parasites, and often in most important part as producers of toxic substances; and in each of these ways they cause modifications in cellular activity and in cellular metabolism. Derangements of nutrition may, if profound or if long maintained, give rise to structural alterations, and these in turn to organic change.

Applying the foregoing considerations to the process or complex of symptoms that we designate inflammation, we would say that any irritant, local or general, infectious, chemic, mechanic, gives rise first within the range of its activity to modification in the nutrition of cells in a larger or smaller area, and as a result of the metabolic disturbances thus generated other irritating substances are set free, that induce further changes, as manifested by local or general heat, vascular constriction and dilatation, cellular multiplication, exudation of fluid, swelling, discoloration, pain, acceleration of heart beat and of respiration, and other well-known symptoms. The results and the products of irritation by aseptic and non-toxic materials differ from those due to septic and toxic substances, and both of these in turn from those due to infectious agents, by reason of differences in chemic affinity and activity, both in quantity and in quality, and in accordance with the localization or dissemination of the infective agents (micro-organisms). The resulting inflammatory changes in local cellular metabolism and activity give rise to the local heat, the local vascular changes, the local increase in cells and exudation of fluid, the local discoloration, swelling and pain; while absorption into the general circulation of the products of the local metabolic abnormality gives rise to the pyrexia, and, alone, or perhaps in conjunction with this, to the acceleration of heart beat and of respiration, the thirst, the headache, the delirium, the convulsions, the coma and the other symptoms, in accordance with the chemic affinities and activities of the metabolic products generated and the cellular area attacked. The inflammatory process is sometimes unattended with pyrexia, and the explanation of this apparent paradox must be sought in the chemic affinities and activities of the metabolic products generated, and reciprocally the reactivity of the nervous mechanism attacked. Bacteria are foreign bodies and, finding lodgment in any tissue, give rise to independent local lesions and processes. Some of the products of cellular activity cause hyperplasia, just as certain nutritive conditions are conducive to the continued existence, activity and multiplication of micro-organisms. Other of these products cause cellular necrosis and degeneration, just as many micro-organisms are destroyed by the products of their own vital

activity and so-called self-limited diseases are in part terminated.

Going a step further and applying the considerations brought forward to our present conceptions of immunity, we would assume that in the natural, hereditary or congenital variety the cells of the body have been endowed, by transmission from the parent or parents, with a certain physiologic activity, in consequence of which, through themselves directly (phagocytosis) and indirectly through the fluids by which they are surrounded (blood, lymph, serum), or substances that they generate (alexins, antilysins, antitoxins), they either repel the invasion of pathogenic bacteria, or failing in this, they counteract the effects of the noxious products to which these give rise. In acquired immunity, on the other hand, the modifications in cellular metabolic equilibrium that are responsible for bactericidal and antitoxic activity are induced through the agency of the chemic substances generated by the specific micro-organisms, either through the disease itself or through inoculation or vaccination or antitoxication. The cells are made by exercise under appropriate stimuli to evolve a latent function.

The nutritive, metabolic and cellular processes that we have been considering briefly apply equally to normal and to morbid states and with especial fittingness to the disorders that we are in the habit of designating functional or idiopathic. Sleep may thus be looked upon as resulting from the action of certain metabolic products upon the higher cellular elements of the central nervous system; narcosis from perhaps others of like kind; thought from the action of other metabolic products; sensation and volition and voluntary action from the operation of still others; and so on, *ad infinitum*. We have long passed the threshold of a specific pathology; it is time that we recognized that we are moving in the domain of a specific physiology. In partial confirmation of this proposition it need only be pointed out that many of the states named, normal or abnormal, can be induced, at least in some degree, by various medicinal agents.

Derangement of the normal metabolism affecting especially the cellular elements of the nervous system may result in wakefulness, in delirium, in insanity, in neurasthenia, in hysteria, in chorea, in epilepsy, and other cognate disorders. Whether the neuron is motile or not is unimportant in this connection. It is probable that it is, as contractility is an essential attribute of all living things. The terminations of neurons are, moreover, not in absolute contact, but rather in approximation, and it is likely that no disturbance of function results from such changes in relation of end-brushes as is constantly taking place. That which is of real importance is the influence that is responsible for all the functions of the neuron, including its contractility, and that is its nutritive state. We would not say that darkness is responsible for the lower temperature of night merely because the two are associated, when we know that it is the withdrawal of the influence of the sun to which both phenomena are due. No more should we, therefore, make the motility of the neuron an essential factor in the physiology or the pathology of the nervous system, as that is but one manifestation of the activity of the nerve-cell. Neurons must vary in size and shape and relation and chemic affinity and activity in accordance with their nutritive and metabolic condition, and it is changes in this state that are responsible for the vari-

ations in functional activity in both health and disease. Changes have been demonstrated to take place in the ganglion cells of fatigued animals and of those subjected to various infectious and toxic processes. Such changes, if long continued or of sufficient intensity, may give rise to permanent structural alterations, such as have also been found after infections and intoxications in both lower animals and men. In this way chronic degenerations arise and death results.

A quotation from a paper¹ read some years ago seems not inappropriate at this point:

Every cell inherits from its parent cell a certain lease of life, at the end of which physiologic death occurs. This period, however, may be influenced by external conditions. Premature death is pathologic. We can not recognize a pathologic longevity. Similar laws apply to the human individual, the composite of a vast aggregation of cells of widely differentiated function. The life of man may be divided into three periods: that of evolution, of growth, of development; that of maturity, of perfection; and that of involution, of decline. The first begins with birth, the last ends with death.

During the period of growth and development, tissue-change and destruction—catabolism—are more than offset by tissue construction and repair—anabolism. Nutrition exceeds waste. Building-up is more active than tearing-down. With the activity of life comes the demand for the highest differentiation of function of which the organism is capable. This represents the perfect individual. For a time, a condition of equilibrium is maintained. Sooner or later, however, the tide begins to turn. The equilibrium is disturbed. Waste exceeds repair. The cellular assimilative function becomes impaired, the constitution of the nutritive fluids defective. Tissues and organs are imperfectly furnished with the materials for their maintenance. Vascular changes occur. In a vicious circle, one baneful influence reacts upon another. The entire organism is reduced to a condition of deterioration. Finally, the state of nutrition falls to so low a level as to be insufficient for the purposes of life, and functional activity comes to a standstill. This is the physiologic process, as it occurs at advanced age, and constitutes the condition of senility. Occurring at an earlier period, however, the process becomes pathologic, recognized clinically by signs and symptoms which may be conveniently included in the designation "premature senility."

As the component parts of the organism depend for their sustenance upon the nutritive elements of the blood, so will their functional stability be governed by the quality and quantity of the circulating medium. Thus, we would be led to look to the blood as containing the excitant which induces the earliest changes. The function of the cell once impaired, the deleterious action of the blood would be augmented by the retention of matters which it was the part of the cell to remove, and the addition of products from the degeneration of the cell.

Other aspects of the results of derangement of metabolic equilibrium have been dwelt upon recently by Riesman², who refers to the products generated in consequence of certain neoplastic and hyperplastic processes and the symptoms resulting therefrom. For this condition he proposes the appropriate designation "metabolic toxemia." So-called internal secretions and their derangements are to be considered in the same connection.

A most valuable contribution to this subject, from the chemico point of view, has been made by Chittenden since this paper was written, in a communication on "Auto-intoxication," presented to the Pathological Society of Philadelphia on April 27, 1899.

¹ A. A. Eshner: Arterio-capillary Fibrosis. Transactions of the Philadelphia County Medical Society, 1891.

² Internal Secretions; Metabolic Toxemia. Phil. Med. Jour., Feb. 4, 1899, p. 270.

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SUBCUTANEOUS RUPTURE OF LARGE ARTERIES FROM CONTUSED WOUNDS.*

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In the treatment of this subject I shall not discuss injuries to the arteries as they usually occur, complicated with grave lacerations of the skin and soft parts, but will limit the scope of this paper to those cases where the force of the injury is so directed against the artery as to rupture its walls, while the skin and soft parts remain practically intact.

As an introduction to the subject, I present the following case: James W., colored, age 23 years, brakeman, while coupling cars at Grand Junction, Tenn., 1 A.M., May 21, 1898, had his right arm caught between the bumpers, the soft parts contused below and above the elbow, the neck of the radius fractured, the vessels ruptured, the skin remaining intact with the exception of slight abrasions of the cuticle in a few places. He was at once attended by a physician, who stated that he would be disabled for some three or four weeks. He arrived in Jackson about 4 A.M., when Dr. J. L. Crook called to see him and dressed the swollen arm in hot antiseptic dressings.

About 10 A.M. we found him suffering greatly, the arm and hand being cold and enormously swollen. There was complete absence of the radial pulse, nor could any pulsation be detected in the ulnar artery. We diagnosed the case as rupture of the brachial artery with great injury to the subcutaneous tissues and probable fracture of the neck of the radius. On account of the enormous distension of the arm, caused by effusion of blood in the intercellular tissue, we could not make a positive diagnosis of the fracture.

To relieve the great swelling and tension I made several punctures into the tissues with a keen narrow bistoury at various points along the under side of elbow and arm and on the back of the hand, which allowed the effused blood to flow out freely until the tension and pain were relieved. The arm was then bathed in hot bichlorid water, wrapped in layers of cotton wrung out of hot bichlorid solution, dry lint applied over this, and bandaged with sufficient support to restrain hemorrhage. The patient expressed himself as being greatly relieved and said that his arm was very comfortable.

I stated to him that it was highly probable he would lose his arm, that the arteries were ruptured and the soft parts and capillaries so badly injured that it was hardly to be expected that sufficient circulation would be carried on to save its life. His reply was that he would never consent to having his arm "cut off," "that he could work his fingers and had some feeling in them."

The next day there was some improvement in the arm, there was feeble capillary circulation down to the metacarpo-phalangeal joints, but no circulation in the large vessels. I continued the same line of treatment, and the condition of the arm remained about the same, only showing a little more sign of returning life, for several days; some blisters, however, appeared near the wrist and along the forearm, but the thumb and all the fingers began to shrivel and assume the condition of dry gangrene back to near the metacarpo-phalangeal articulation. The patient was free from fever, comfortable, with a good appe-

* Read before the Tennessee Medical Society, Nashville, April 11, 1899.