Sensation and Pain

SENSATION AND PAIN

BY

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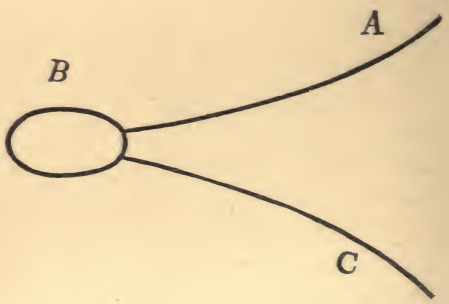
SENSATION AND PAIN.

THE limits of a single lecture are too small to give any adequate idea of the complicated structures and processes by which we experience what we call sensation and pain. But my primary object being to obtain some practical deductions from certain *basic facts* connected with the phenomena of sensation and pain, rather than to entertain you with a detailed exposition of the subject, I must beg your attention while I give, as necessary to a proper understanding of conclusions which will be ultimately arrived at, a brief outline of some of the main and primary facts of nerve-structure and nervous action. In doing this, I shall not enter any debatable ground, as between physiologists and metaphysicians, but shall simply lead you a little way over a very common road.

You will see, in Fig. 1, an ideal illustration of the simplest form of a nervous system, as it appears to have been actually differentiated; whether "evolved," one order from the preceding, or specially created, one order after another, it is not necessary to our present purpose to inquire. It consists of a nerve-tract passing from without inwardly where it joins a highly endowed structure called a *nerve-centre*. And from this so-called nerve-centre there goes another nerve-tract which proceeds outwardly to some structure which is to be excited to action.

FIG. 1.

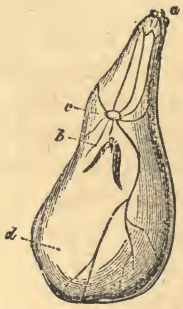


If A, in the figure A, B, C, (Fig. 1) be touched, an impulse is produced which is conveyed along the nerve-tract, A, B, to the nerve-centre, B, where a re-

markable thing happens: the impulse of the touch causes a change to take place in the highly unstable substance of the nerve-centre, which so modifies it, that one of another quality is sent out along the nerve which proceeds from the centre and it becomes now a *motor* impulse—or an impulse which causes the organ to which it proceeds to act: if a muscle to contract; if a gland to secrete, etc. Speaking generally, there can be no functional action of any organ without an appropriate supply of nervous stimulus. But the nervous stimulus thus supplied, is what is denominated *reflex;* that is, it proceeds from an impulse set up by external agency, is transmitted to the nerve-centre, inducing there a disturbance of such a nature that a motor impulse is sent off along a nerve proceeding from the centre, with the effect of causing some kind of action in the organ to which it goes.

In this ideal illustration of the *plan* of nervous action, I have supposed, for the more easy comprehension of the subject, but a single nerve-fibre as a nerve-tract, and a single cell as a nerve-centre. In reality there are many nerve-fibres in every nerve-tract, and many nerve-cells entering into the structure of every nerve-centre; in fact, vast numbers of them go to make up a very small centre of nervous force.

FIG. 2.

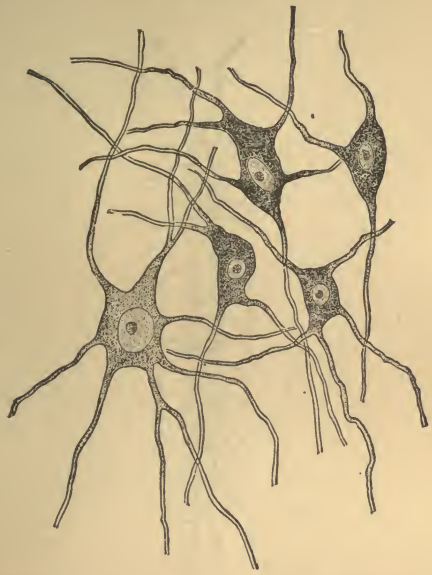


Nervous System of the Ascidian.
[FROM CARPENTER'S MENTAL PHYSIOLOGY.]

The next figure (Fig. 2) represents the nervous system of the Ascidian. There is a single nerve-centre with two or three pairs of nerves communicating with the mouth, vent and body of the creature. Now if these nerve-tracts be straightened out, we should have an arrangement of the nervous system almost as simple as the ideal one represented in figure 1.

Here (Fig. 3) are several nerve-cells, highly magnified, and their intimate relations through connecting fibres are also to be seen. It is this arrangement of sensitive nerves to carry an impulse inward, and of nerve-centres to receive and evolve energy,

FIG. 3.



Nerve Cells—Gray Matter—Magnified.
[FROM DALTON'S PHYSIOLOGY—DEAN.]

independently of consciousness and will, which makes life possible.

Neither man nor the lower orders of creatures could exist except for the constantly acting agency of reflex nervous action. A single example will sufficiently illustrate reflex nervous action in the lower orders.

Fig. 4.

Nervous System of the Centipede.
[From Carpenter's Mental Physiology.]

In the nervous system of the centipede (Fig. 4) we find a series of nerve-centres corresponding with each pair of its many legs. The touch of the feet upon the floor creates a sensory impulse which, being transmitted to the corresponding nerve-centre, throws the unstable material of which it is composed

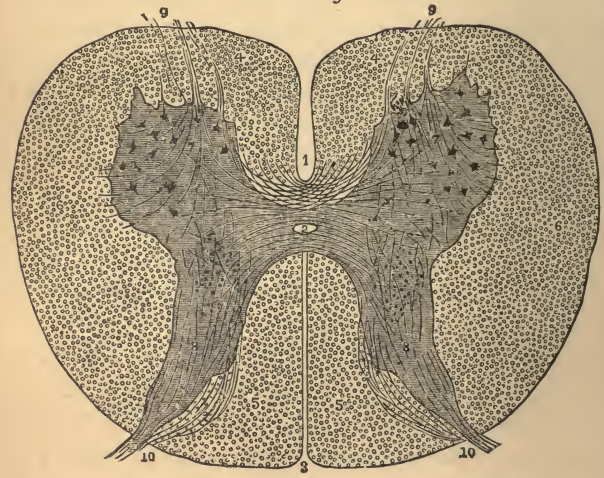
into excitement and change, during which a motor impulse is developed which is conveyed back to the muscles of the legs and they are thus, each time, successively and renewedly set in motion by their own impress upon the ground, without the aid of consciousness and volition. For, let this creature run over the table and, while at full speed, snip off his head with the scissors and he will continue to run, apparently as well as before, until he meets with an obstacle.

I said that animal life could not exist without the part played by reflex nervous action. This is just as true of the higher Mammalia and Man as of the centipede or the jelly fish.

In the next figure (Fig. 5) you may see a magnified representation of a transverse section of the human spinal cord. The spinal cord may be considered as a prolongation downwards of the brain, with which it is most intimately connected. It is composed of two parts; the inner or gray portion is the seat of the nerve-centres for each pair of nerves which are sent off at every vertebra. The external or white portion is composed, principally, of conducting nerve-fibres for the transmission of nervous impulses in both directions. The internal or gray portion is made up of the highly endowed, exceedingly unstable nerve-cells, constituting "nerve-centres," which under stimuli, have the faculty of transforming

sensory impulses into motor impulses as before mentioned.

FIG. 5.



Transverse Section of Human Spinal Cord.
[FROM DALTON'S HUMAN PHYSIOLOGY.]

Although the spinal cord of the higher vertebrates is not anatomically separated into distinct ganglionic bulbs, as is seen in that of the centipede, the reflex function is not less; but the relation between the different nerve-centres is rendered immensely greater and more intimate by the great multitude of connecting nerve-fibres. When we speak of sen-

sory and motor nerves, we mean entirely distinct nerve-fibres which pass from without to the centre and which pass from the centre outward to all the organs. These different tracts of different nerves with different offices to perform, have names given to them according to their respective offices. The sensory is as often called the afferent nerve because it transmits the impulse originating externally in reference to the centre, towards the centre; and the motor is as often called the efferent nerve because it conveys the motor energy developed in the nerve-centre outwardly toward the organ to be excited to action. The sensory or afferent nerves enter the spinal cord behind and communicate directly with the gray matter; and the anterior or motor fibres arise in the gray matter and pass out in front. But the anterior and posterior portions (or "roots") soon unite and form one nervous tract in their distribution throughout the body. But the ultimate nerve-fibres are kept entirely distinct throughout their distribution. I will now remark that, in the diagram first shown, the tracts of the sensory and motor nerves were figured distinct from each other for the purpose of greater definiteness in presenting the ideas of afferent and efferent nerve-tracts. They are, in reality, bound up in the same bundle immediately after leaving the spinal cord.

Thus we have the three elements co-operating in

the production of every physiological act; the sensory nerve to convey inwardly an impulse set in motion by external causes; the nerve-centre excited to active change by the stimulus received, and the motor nerve to transmit the energy generated in the nerve-centre to the destined organ, which, in its turn is excited to action. The plan of nervous action is simple enough when thus analyzed.

I wish now to call your attention to the important fact that all nervous action consists of pulses, throbs, ebullitions or explosions of nervous energy, according to the degree of action. There is a rising under sensory stimulus, a pulse of excitement, and a discharge of energy, and then a subsidence, followed by never-ending quiescence, unless the centre is again stimulated from some source external to itself. It is important that this fact—the pulse and subsidence of activity in the nerve-centre—should be kept in mind, because it is one of the basic facts of sensation and, in fact, of all nervous phenomena. The pulse of activity in a nerve-centre under a sensory stimulus, during which a motor impulse is generated, may be illustrated, perhaps, in a crude way, by comparison with the Geysers or "Spouting Springs," so far as the periodical exhibition of force, depending on exciting causes and determining conditions, may serve to illustrate. As in the Geysers, there would

be no activity of the waters except there was a flowing in from surrounding media, an accumulation of heat, steam and pressure, a throb of uncontainable forces and a belching forth of the waters, followed by subsidence until the same conditions recur; so the nerve-centres never act except under the compulsion of sensory stimulation, and the different organs of the body would be forever dormant except for the energy developed in the nerve-centres which sets their dormant powers into action.

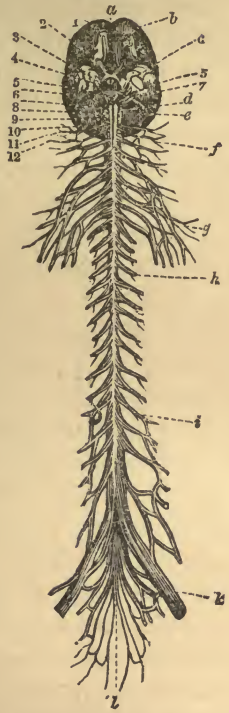
Thus we see the fundamental part which sensation plays in animate beings. In fact the term "sentient beings" is often employed as synonymous with animal life.

But while we have been speaking of "sensory impulses," we have not yet reached conscious sensation. Let us proceed a step further in our investigations. Referring again to our diagram representing the nervous system of the centipede (Fig. 4), we see a succession of ganglia, or little brains, connected together by slender nervous fibres and terminating in one ganglion which throws out prolongations, not to a pair of legs but to a pair of end organs, namely, a pair of eyes. That is, the branches of the anterior ganglion communicate with organs more highly developed than are the feet. Now when the creature

approaches an obstacle or an enemy, this terminal ganglion of the series becomes affected and sends back an inhibitory impulse, which, according to its nature and degree, either modifies the automatic action, as before described, so as to turn the creature to one side; or, perhaps, arrests further progress by entire inhibition. Other language would be to say that the creature *sees* the obstacle or the enemy and the controlling influence of the more highly endowed terminal ganglion is set up.

Passing at a single step from those simple forms of life which I have illustrated, for convenience, by the nervous system of the centipede, (Fig. 4) whose movements are directly reflex, or reflex modified by the inhibitions of more highly developed "end organs" or eyes and their specialized ganglion, we come at once to the most highly differentiated and endowed nervous system of all, that of man. Referring to the figure (Fig. 6), we see, that instead of a series of bulbs, with a terminal bulb more or less specialized, we have a mass, anatomically continuous, and terminating in a structure so enormously expanded as to be properly denominated the "central" organ of the whole nervous system. But in acquiring continuity of structure, the spinal cord has lost none of its qualities as a series of nerve-centres.

FIG. 6.



Nervous System of Man—Brain and Spinal Cord.
[FROM ORTON'S ZOOLOGY.]

It is with the brain as a central nerve-organ—a congeries of differentiated and highly specialized

nerve-centres, a nerve-centre of the nerve-centres —that we have more especially to do.

I have used the simpler forms of reflex nervous action as illustrative incidents with which to render more clear the phenomena of all nervous action,—the excitation by stimuli, the pulse or throb or ebullition or explosion of energy, according to the degree of stimulation in the nerve-centre, with the discharge of a motor impulse to excite action in the organ to which it is sent,—in order that you may have a clear conception of what takes place in that centre of centres, the brain itself. For the brain is only a nerve-centre—with extraordinary endowments, and of immense size, to be sure—but it is a nerve-centre still. And it acts only as it is incited to action by stimuli, exactly the same as the simplest nerve-centre that controls the motions of an ascidian or a single pair of a centipede's legs. But with this difference that, whereas the simple nerve-centres of the lower orders of creatures receive impulses from without along afferent or sensory nerve-tracts, without power of origination of sensory impulses, the brain seems to have this power of central self-stimulation. In other language, the brain seems to be capable of receiving stimuli from two directions, viz.: from the direction of the body and the external media, through the senses, and also from

the direction of that unknown and unknowable something which we denominate the Mind. But, whether the stimulus comes from the direction of the various senses, or from that of the mind, the important fact remains that the effect produced is precisely the same in each case. The difference, where difference exists, is one of degree, never of kind. For, instance, the thought of a friend or an enemy produces the same kind of throb in the cerebral centre that the sight of a friend or an enemy produces. The thought of food causes a cerebral pulse which produces the same sensations as the sight of it, differing only in degree. It is these centrally originating sensations which we are more particularly to study, in our consideration of sensation and pain, in this discussion.

A sensory impulse—it may be of touch, sight, taste, hearing, the muscular sense or that of hunger, no matter what, provided it originates outside the sensorium—is transmitted, first to its own nerve-centres on its way to the sensorium, producing everywhere its own appropriate reflex influences, until finally it reaches the great nerve-centre, the brain. Here we become conscious of the impulse which has been transmitted towards, and has now reached the brain only through the pulse or throb of action which has been produced in the unstable substance of the

brain nerve-cells precisely the same as the minor nerve-centres respond to the same impulse, on its passage to the brain. And, on the other hand, the same changes take place in the nerve-cells when the sensory impulse is centrally initiated, as when it comes from without this centre. So that the brain as a centre is continually subjected to the double influence of peripheral and central sensory excitation. How it acts under these two and diverse sources of sensory impulse, it is the main purpose of this essay to inquire.

There is no way to study one kind of nerve-centre stimulus without comparing it with all other forms. Let us briefly consider how we become conscious of anything: that is, how an ordinary sensory impulse becomes, on reaching the sensorium, a conscious sensation. There are only two ways by which a sensation can become a cognition—by repetition and by comparison with other sensations of different kinds and of the same kind. In other words, by the relations of differences. We are incapable of perceiving anything but differences. It may be differences of kind or of degree or of time. But there must be a change (or difference) in one or more of these three kinds of differences, or we immediately cease to feel.

It is the law of nervous action that a sensation, once transmitted, is more easily transmitted along

the same nerve-tract and more readily and more deeply affects the same nerve-centres afterwards; and in proportion as the same sensation is repeated over the same tract, the transmission is not only the more easily accomplished but all the reflex influences are similarly facilitated. Hence dexterity acquired by practice in any art or act—dexterity being but another word for well-organized reflexes—is simply the result of the impressions which have frequently passed through the same nerve-tracts with repetitions of the same pulses of molecular change in the same nerve-centres. At last, we may say, the tract has been made and worn smooth and what is called a "habit" is formed. That is, there has been such an alteration in the nervous tracts and in the nerve-centres that the impression has become fixed in the very structures of the nerves themselves. This is memory in its primitive and representative character. In walking over the abyss below Niagara Falls on a tight rope, Blondin could hardly have fallen, for the co-ordinated memories of all his past experiences so controlled his movements that it would have been difficult for his will to seriously interfere with his reflexes.

But subjection to the influence of sensations which have gone before, of the *same* kind, is modified by the equally important influence of preceding sensations of *different* kinds. The effect on a nerve-cen-

tre, of a touch on the leaves of a rose, would be represented by a certain quality and degree, at one moment; but the changes represented by the pleasurable sensation, would be modified if not entirely overcome by other and more intense activities set up by the pricking of a finger by a thorn concealed among the leaves.

It must, therefore, be remembered that, while we may assume, for the purpose of simplifying the description, that there are simple sensations, such simple sensations never actually occur. The most that can be said is that there are always *paramount* sensations—sensations which exert a paramount influence, momentary or prolonged, over the changes which are always pulsing in the nerve-centres. The prick of the thorn, in the preceding illustration, causes a sensation which is sufficient to displace the ordinary sensation of touch on the rose leaves. A child asleep may withdraw the hand by simple reflex action when a fly alights on it, but if a larger fly alights on the other hand, the stronger impression made by the larger fly will cause *that* hand to be removed while the lesser sensation will remain unmanifested in reflex action. What is true of the simpler reflex action of the smaller nerve-centres is equally true of the great cerebral nerve-centre. We cannot entertain two entire sensory impressions at the same moment of time. Either one

will be paramount and the other subordinate or each impression will be diminished so that their united influence will only equal what either would be alone. The same is as true of painful sensations as of ordinary feelings. A man with both legs broken feels pain in but one at a time. I remember a case to which I was called in consultation with the late Dr. Peaslee, where a lady, while in the country, had dislocated the knee joint. After a great deal of suffering she was finally brought to Dr. Peaslee, when he found that the knee had not only been dislocated but the bone had been broken a few inches below the knee. The pain from a dislocated knee had been so much greater than that from the simple fracture that she did not recognize any pain at all at the point of fracture. The same thing takes place continually with reference to all our sensations, whether of pleasure or pain; we are only conscious of what may be the paramount influence. But it must not be supposed that what happens to be the paramount impression, whether on the simpler nerve-centres or on the sensorium and the consciousness, must necessarily arise from a cause of paramount importance. On the contrary, reflex action, as well as consciousness, depends so largely on attention and habit that a cause of comparatively little importance may set up action in the nerve-centres and affect consciousness in

a manner out of all proper proportion to its real importance.

The effect of sensory impressions on the reflex actions as well as on the consciousness, depends on a great variety of interacting causes; so that we are obliged to begin a successful study of the phenomena of conscious life, by distrusting and discounting the evidence of our senses in advance. I mean, of course, conclusions drawn from mere sensations. Alone, they are not evidence of anything; and, without support, they are not to be trusted as sufficient evidence of positive facts. The rays of light reflected from a luminous body fall on your retina. A sensory impulse is produced in the rods and cones of the eye which travels back to the sensorium and we become conscious of a certain sensation. We say we see a man. That is, we arrive at the visual judgment that, at a certain distance, a man is standing. The combined experience of all our other senses and of many years use of the visual sense leads us to *conclude* that a man is there. But if the same size, shape, direction and intensity of luminous rays had never fallen on the retina before; and if we had never felt the shape or heard the voice of a man, so as to bring to our aid the experience derived from other senses, we could not know that the luminous object represented a man. The sensation of what we call sight would, taken alone

and without the corrections of experience, be quite insufficient from which to form correct ideas. When we say we "see" certain objects, we mean that our visual judgment determines that such an object is there. Children blind with congenital cataract illustrate the imperfection of the visual sensation and the part which visual judgments play, in the conclusions drawn from the sensations caused by the luminous rays which fall on the retina from external objects. When sight is restored, on removal of the cataract, the patient finds himself bewildered by the possession of sight. He cannot judge of distances, shapes and qualities by sight alone, but must continually supplement vision by comparison with other senses, which have already furnished him experience. He cannot tell the difference in the shape of a disk or a ball; or the edge of a disk from a straight line. The relative distances of objects he gets no accurate idea of, from sight alone, and he occupies a considerable time in correcting the sensations yielded by his eyes by using the other senses, mainly that of touch, concerning which he has already formed actual judgments, or experiences. If one of us had never seen, and should suddenly open his eyes and behold the moon for the first time he would be just as likely to reach out his hand to grasp it as an infant.

It may assist us to comprehend the mixed and

largely subjective nature of all our sensations, to consider how impossible it is to be otherwise. What we denominate "seeing" a thing is made up of many different factors and is not the simple process which, without reflection, it might seem to be. First, there is an impression made on the sensitive structures of the retina by the rays of light coming from a luminous body, but this light has been a certain length of time in coming. If from the sun, nine minutes nave passed since the rays left him. Whatever the distance, it is certain that the thing seen is not exactly the same that it was when the rays producing the sensation of sight left it. Light leaving the nearest fixed star is three and a quarter years in reaching the earth. So that in case that star had suddenly gone out (something which has happened), we should be seeing the star more than three years after it had ceased to exist. Of course we should not be seeing the star when it did not exist. It is only that certain sensations cause the visual judgment that a star is there—a judgment which is more than three years mistaken. It is the same with the sensation of sound. We do not hear the bell ring in the strict sense of that term. Sound travels at the rate of about 1,093 feet per second; so that, if we are some distance away, the vibrations which reach the ear, at any given moment, are not the same as those actually being given off at that moment. Nevertheless, our

accumulated experience enables us to form a sense-judgment concerning the substance that produces the vibrations in the air; and that is what we call hearing.

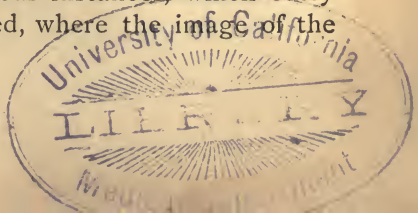
But it also requires appreciable time for the sensations to be transmitted along the afferent nerves. It requires another appreciable length of time for the pulse of excitement in the nerve-centre to take place, and it requires still another space of time for the motor impulse to be carried to its appropriate organ. Some idea of the element of *time* may be got, perhaps from the illustration made by Mr. Richard A. Proctor, in a lecture which I heard, several years ago. In endeavoring to assist his audience to a conception of the enormous distance of the sun from the earth, he used this illustration: he said that if a child, lying in his cradle, had an arm long enough to reach the sun, and should stretch it out and, hitting the sun, should burn his finger, it would require more than one hundred years for the sensation to reach his brain; so that, to use an Hibernianism, reckoning his life at fourscore years, he would have been dead more than twenty years before he would know he had been burned. The same illustration assists our conception of the appreciable length of time required for the transmission of sensation.

According to Prof. Dalton, voluntary *motor* im-

pulses travel through the spinal cord at the rate of *ten* metres a second; while they travel through the spinal nerves at the rate of *twenty-seven* metres per second. But *tactile* impressions travel at the rate of *forty-two* metres a second through the spinal cord, while *painful* impressions are transmitted at the rate of only *ten* metres per second. The changes which take place in the brain and which accompany the act of perception, also occupy an appreciable length of time for their accomplishment. Sensation is not that instantaneous and simple act which, without a certain amount of positive knowledge, it might seem; it is a very complicated process.

But if an appreciable length of time is required for a sensory impression to become a conscious sensation, a considerably longer time is required for such a sensation to pass away. The sensory apparatus, once excited, does not immediately subside into a non-active state, but the pulse or wave of molecular change which has been set up in the nerve-centres remains for a longer or shorter time. A lighted match, rapidly revolved, appears like a circle of fire because the impression made by the light, while at a certain point, does not subside before the luminous object is back again at the same point. Hence we say we see a circle of fire although we know as a matter of fact, that it is a point of

fire which we see. In other words, our sensations do not agree with our knowledge. So we do not see the separate spokes, in a revolving carriage wheel, because the impression made by one does not entirely fade away before another has been made on the sense of sight. There are several familiar children's toys in which the fact of the lingering of visual sensations is taken advantage of. One consists of figures of a man in the different postures which a gymnast assumes in leaping through a hoop. These are printed on a strip of paper which is then wound around a wheel and made to revolve before the eye which looks through a hole. One figure follows another so closely, as the wheel revolves, that one impression has not faded before the next is made and instead of many figures in different positions, there seems to be but one which changes its positions as if it were alive and rapidly leaping through a hoop. But, on the other hand a wheel revolving rapidly in the dark, appears to stand still, with every spoke distinctly visible, when seen by the discharge of lightning or an electric spark. This is because there are no previous sensations waiting over to be merged with those that follow. But even more striking cases of the continuance of visual sensations after removal of the luminous object, are those numerous instances, which every person may have noticed, where the image of the



object remains for a considerable time and of a different color: the color depending on that of the surrounding objects. These are called "after images." They are of two kinds; positive after-images and negative after-images.* If we look at the sun the image of that body remains for a long time afterwards. If we look at the window on first opening our eyes in the morning, and then close them, there remains an image of the window-sashes and objects near it. If we look at a white patch on a black ground, and then turn the eye to a white ground, we see a gray patch for a little time. And a black patch on a white ground gives rise to an image of a white patch, when seen and the eyes shut immediately afterwards. So also when a red patch is looked at, the negative image is a green-blue—the complementary color. And so on, with a large number of interesting experiments. It is beyond the scope of this lecture to enter into detailed explanations, my object being merely to state certain facts showing the inadequacy of ordinary sensation to give us correct conceptions, without the aid of comparison and experience.

We have the visual sensations from objects mirrored in two eyes yet perceive only one; the image, on the retina, is inverted, yet we perceive men standing on their feet and not on their heads; we often hear

* This description is a summary from Foster's Physiology, P. 551.

sounds as if coming from the north or east whereas they actually come from the south or west; we think they come from one distance, according to various judgment-reasons, when they actually come from more near or remote distances than we inferred from the volume or quality of the sound; Isaac's touch was not delicate enough to distinguish between the goat's hair on wily Jacob's hands and hairy Esau's natural covering; I knew a whole family which ate horse-meat steak with hearty relish, not knowing it by taste from beef, until told, when their enjoyment ceased at once. The sense of smell does not always exist, in this catarrhal country, and when not impaired, this sense in man, is the least reliable of all. What we know of the distance, size, shape of objects is only suggested by the rays of light emitted or reflected and subtending certain angles on the retina, and not directly imparted by what we denominate sight. Mountains appear nearer in clear weather because we can then see objects more distinctly; that is, with better defined and sharper outlines, and not because there is any increase in the angles of light coming from the objects and outlines of the landscape. As nearer objects are usually seen more easily, when we can see objects clearly which are obscure, in ordinary states of the atmosphere, we say they are not so far away. But when we have had no experience, or when there is

nothing with which to compare, it is frequently astonishing how far from the facts our sight impressions are. A lady in my family said she saw a meteor fall between her window and the house on the other side of the street. From the accounts afterwards given, the estimates of observers, at different locations and distances, placed the meteor about forty miles away. Every one knows how difficult it is to form accurate conceptions of distances at sea or concerning objects across a level plain the breadth of which is unknown. Men standing beside an object which is taller than we expect, are made to appear shorter than they are; while they look taller if beside an object which is less high than we had conceived it to be.

Indeed, our love of Art, the grand and the beautiful, depends largely on the fact that many things may be suggested by a few. A few properly placed lines, may suggest a horse or a sheep or a mountain —as witness the Japanese constant reproduction, to the mind, of their sacred mountain, Fusiyama, on almost all their works of Art, by about three or four properly placed simple lines. A picture is more or less perfect, in a certain sense, according as the artist has the power of making his work suggest more than it contains. Caricature depends almost entirely on what it suggests rather than on what it contains. Hence, a caricature can never be an artistically fin-

ished picture. And, on the other hand, there are many artistically finished pictures which are not suggestive and consequently valueless, because they excite in the mind little or nothing beyond what is actually painted in. Many a bright boy in school, wrestling with the inspiration of mischief, has produced, with slate and pencil, a few lines containing whole epics of suggestion which many broad canvases of labored technique fail to do.

Yet, without the several senses the human mind would remain a blank forever. While the sense of touch, sight, hearing, taste and smell impart very little directly to our consciousness, when they are repeated millions of times and the recorded impressions are compared with themselves and with each other, and all the possible combinations with themselves and with each other are raised in consciousness by a single sensation, there is established a substantial sub-structure of memory, ideas and perception, the arrangement, development and proper exercise of which constitutes what we dominate culture. We thus bring under observation certain determinate qualities which we call *mind.*

Heretofore, we have almost exclusively considered sensation as coming from without the nerve-centres. Rays of light have fallen on the retina through which we become conscious of light and shade; we reach forth our hand and we become

conscious of something touched: the air is set into vibratory waves which, falling on the ear, give us the auditory sensation; particles of matter floating in the air come in contact with the lining membrane of the nasal passages and we have the sensation of smelling; and when certain other particles of matter mingle with the salivary secretion and buccal mucus we have the sensation of taste. We have also seen how, under the influence of comparative and multiplied sensations, the nerve-centres become modified in their action, so that after awhile a slight sensory impulse is sufficient to arouse as much action as a stronger one could do at first. So that sensations become practically incorporated into the very substance of nerve-structures. And, finally, that with the infinite connections and relations of sensations, one sensation is capable of calling up other and not directly related sensations, or memories of past sensations, until we perceive, in consciousness, not a single sensation but many combined sensations or the memories of sensations, rising to the stimulus of a single sensation. Thus the odor from the kitchen may suggest the deer which furnished the venison. And from such an incitement, we may have called up to the mental consciousness, forests, lakes and stalwart hunters; or, perhaps, the last camp on the mountain, the trout in the lake, the guide and his dog. But it is not necessary that

there should be an actual peripheric impulse, transmitted through an afferent nerve to the sensorium, in order to recall or re-excite the nerve-centres to the same action that was first produced by the sight, or smell or hearing. The *mind* acts on the nerve-centres the same as external objects do. When we recall the face of a friend, the picture in the mind is the same as when we perceive him through the sensation caused by his image on our retina. The image called up in memory may not be quite as vivid, but the difference is one of degree only. And it may happen, even, that the memory is the more intense.

These centrally initiated sensory impulses will now claim our attention. The subject is, in my opinion, one of vast import to civilized and cultivated people and I beg your serious attention while I briefly unfold my meaning.

I cannot better make clear to you the difference between centrally and externally excited sensations than by relating an actual occurrence. A young lady friend was staying with one of my daughters one night, when, after talking a long while—as young ladies will do—my daughter said, "Now let us stop talking and go to sleep, we must both be asleep in three minutes." They immediately composed themselves to sleep. After a couple of minutes of perfect quietness, my daughter exclaimed,

"How do you suppose I can sleep when you are counting?" She says she heard her friend counting with perfect distinctness. Her friend replied: "I am not counting aloud." After a little dispute it was ascertained that the young lady had been counting (as is often done to assist in getting to sleep) but counted in groups of tens, with pauses between each group. While the counting which my daughter heard was straightforward enumeration. So it was certain that the young lady had not unconsciously spoken her numbers, which my daughter had heard, but that the latter had unconsciously initiated the impulse which had acted on her nerve-centres the same as an auditory sensation would have done. And so far as her senses could inform her, she had actually heard words which were never spoken. Except for the circumstance that the lady friend was counting in groups of numerals with pauses between each group, either of two explanations might be given, neither of which would be true. It might be said that she had counted aloud without being conscious of the fact; or it might be called a case of so-called mind-reading. Whereas it was simply one of those numerous cases of centrally initiated sensations which cannot be distinguished from externally excited or ordinary sensations. While, in this instance, the means existed for correcting the error, by proving that my

daughter could not possibly have heard the words which she perceived distinctly as auditory sensations, in most instances, of the same nature, there is no direct way to correct the mistake as to the source of the sensation. Only when we understand how few and imperfect are our perceptions which come directly through the senses, and how they must be continually converted into judgment-sensations before they are at all trustworthy, can we comprehend the utterly unreliable character of sensations and impressions which arise into consciousness from central initiation. In fact, a large portion of our lives is spent in being deceived by our senses; in finding the mistakes and in efforts towards correcting them.

Nothing is less true than that one can believe the evidence of his senses. On the fact that we ought not so to believe is based nearly all the tricks of jugglers, and the manifestations of mediums and clairvoyants, and the phenomena of the trance state. The two latter apparitions are wholly subjective conditions (when not pure deceptions) and the former depends almost entirely on the simplicity of the audience. We look where the performer desires us to look—to engage our attention is his stock in trade—and his supposed "tricks" are often the most ordinary acts done under our very eyes.

Some twenty years ago, I saw, for the first time,

the then renowned wizard, Anderson. The exhibition made a great impression on me. How was it possible for him to do all those wonderful things? After reflecting some days, I asked myself, "Did he do the things as they seemed to us?" I had noticed that he had a great deal to say which was not at all relevant to the performance—as I then understood it. I have since learned that the essential part of a juggler's skill consists in a judicious use of apparently irrelevant matter. To test the theory which I had formed that a juggler's skill consists largely in the facility with which an audience allows its attention to be occupied with the most frivolous things, while changes are made right under their eyes, I determined to attend again, this time to look everywhere except where the performer seemed to desire. The result was that I saw that a large proportion of the apparently marvellous tricks were very tame transferrings from box to box and place to place, while attention was kept occupied with something else. This discovery made the performance very tame and uninteresting, and it was many years before I had interest enough to see another of a similar nature. Heller's tricks were very skilfully done and they contained more that was collusive with his assistants — as the so-called mind-reading—but even then, any one who kept his wits about him and refused to allow

his attention to be controlled by the performer, could see that nearly everything depended on the same principle of not seeing anything except that which is presented to the mind by the performer.

Many things, entirely unnoticed otherwise, would be plain and simple enough, when one kept command of his own attention.

Attention plays an important part in the phe nomena of sensation and perception. A sensation which would pass unnoticed in consciousness, while the attention is engaged with something else, becomes apparent so soon as the diversion ceases. So also, the same sensation which is barely perceptible, to the unoccupied consciousness, may become acutely sensible when intense expectation is aroused regarding it.

Because we are not conscious of having seen a reputed occurrence, is not sufficient proof that the occurrence did not happen in our presence. Several persons witnessing something happening in the street seldom entirely agree as to what actually took place. Divergence immediately arises from the fact that certain parts of an occurrence make stronger impressions on some than on others; and, consequently more completely occupy the attention to the exclusion of other acts which similarly impress other witnesses. At the same time, the persons witnessing the occurrence, may all actually see the

same events, so far as the visual images are concerned. Hence, begin, at the very moment of the happening of any acts, preparations for radical divergences of statements (all equally truthful, so far as the intentions are concerned), concerning facts, thus rendering human testimony unreliable unless we subject every statement of fact to careful analysis. Thus with ordinary evidence of the senses. It will be seen, when we come to consider subjective sensations, that human testimony, growing out of subjective states, is still more untrustworthy.

The disposition abides in every one to perceive only that which the attention, for many reasons of accident, temperament and circumstance, fastens on and is occupied by, to the exclusion of all things else.

I read somewhere this relation: an eminent surgeon was called to see a patient, not far from London, in consultation with the family doctor. The gentleman had two daughters who waited, in much anxiety, for the result of the professional examination. At last the surgeon came into the room where the family were waiting, with this remark: "Your father is very ill and he is not likely to permanently recover from his disease. But he will get much better, will be comfortable and will live many years." At which both daughters exclaimed together, the one—"The Lord have mercy, father

will die!" and the other, "Thank God, father will get well," each giving attention only to words which suited her temperament and expectations. It is precisely the same in occurrences which we hear and see every day of our lives. We, consciously, hear and see only parts of what actually happens and, as we have already pointed out, we hear and see imperfectly that which we hear and see at all. And the same of all the senses.

That sensation which rises into consciousness is seldom a complete representative of the sensory impulse which is the occasion of the perception. The sensation perceived may resemble, more or less closely, the impulse which occasioned it, or it may have no recognizable relation to the original. A patient called at my office, one day, in a state of great excitement from the effects of an offensive odor in the horse-car she had come in, and which she declared had probably emanated from some very sick person who must have been just carried in it. There could be no doubt that something had affected her seriously for she was very pale, with nausea, difficulty in breathing and other evidences of bodily and mental stress. I succeeded, after some difficulty and time, in quieting her, and she left, protesting that the smell was unlike anything she had ever before experienced and was something dreadful. Leaving my office soon

after, it so happened that I found her at the street corner, waiting for a car: we thus entered the car together. She immediately called my attention to the same sickening odor which she had experienced in the other car and began to be affected the same as before, when I pointed out to her that the smell was simply that which always emanates from the straw which has been in stables. She quickly recognized it as the same, when the unpleasant effects which arose while she was possessed with another perception of its character, at once passed away. In this case, we may say that the sensation which arose into consciousness through the special sense of smell, was so quickly displaced by the sensation which arose out of central initiation that the former was not recognized; the combination of sensations arising out of the cerebral excitation which she could only name as something very bad, taking its place. It is to be remarked that the effect in consciousness was precisely the same as if there had been in the car an odor of the character which she had represented.

I select another instance of the effect, on the senses, of previous mental impressions. A gentleman, of my acquaintance, had the sight of the right eye nearly destroyed by a rapidly formed cataract. At first his vision was seriously impaired. But, after a while, he found that, as a matter of habit,

he always endeavored to see with the right or affected eye, and that, whether he used both eyes or only the affected one, his vision was defective. But, by covering the unsound eye, he could see perfectly. He then instituted a course of training in the use of the sound eye, and, after a little time, he could see perfectly while using both eyes, the perfect image formed in the sound eye rising in consciousness instead of the defective image of the unsound eye. This is illustrated in the following experiment: in looking at a street light, several blocks away, if he covers the sound eye, he can see only a thin crescent of light at the upper and inside border of the light, the larger portion being covered by the darkness of the opaque portion of the lense. But when after thus looking, he attempts to see with both eyes, he can see little more than with the unsound eye. But when he covers the affected eye, he can see perfectly well, and continues to see perfectly well after uncovering the unsound eye, the image from the sound eye rising into consciousness when the impression has been once established. In other words, this gentleman has trained his brain to take the impression originating in the sound eye instead of that received from the unsound eye. That is to say, he has either a perfect or an imperfect image in his mind according to which his attention may have been last directed.

While a vast number of sensations are first suggested or at least receive their first impulse from peripheric sources, acting through one or more of the special senses, it is by no means necessary that this should be the case at all. Centrally initiated sensations engage by far the greater portion of our conscious perceptions. We call up, alone or in various combinations, the sensations which we have previously received and which constitute our previous sensory existence. Each sensation leaves its impression in the very constitution of our bodily organism. We are different, after receiving certain sensations, from what we would be if we had been placed in different circumstances and had received other sensations. Not only this, but we may use our stock of accumulated sensations in one way with one kind and degree of modification of the original sensations, or in another way with another kind and degree of modification of the same sensations. In other words, we can modify ourselves.

And here we arrive at the very pith and marrow of the matter. Up to a certain point and in a certain degree and manner, we are unquestionably automata. If it were otherwise, life would be simply impossible. The sensations which we receive through the five senses set a-going certain machinery, the result of which is sensory life, as certainly

as the opened valve lets in the steam which makes the ponderous engine throb with motion and power. But steam, having once been used, flows out lifeless, a simple waste. Not so the sensations. Once received, they are never wholly spent, but, in various forms, remain as a portion of our vital selves, so long as we live. And, once received, we may use and control their accumulated substance, much as we will. The reflexes should also be under the control of the central forces: of the will. Let me illustrate how this is not always the case. As I write, a patient relates her experience as follows: on a certain time she, with other members of her family, was out in the garden watching the Northern Lights which were very beautiful that evening. She said that they seemed to radiate from a certain centre and passed, in long waves and lines of light, into the more distant parts of the heavens. And while she was standing there she felt the electricity streaking down her back and prickling all over her, until, finally, she had to go in. Of course, there was no electricity and the sensations suggested by the lines of light, rapidly forming and dispersing, were purely subjective. I do not call them imaginary, in any correct use of that word. Unquestionably, the feeling excited by the occasion, amounted to ebullitions or explosions and discharges of force in the cerebral nerve-centres, which were sufficient to arise in con-

sciousness, and these centrally induced sensations were referred, as all feelings are apt to be, to the periphery. Having a feeling, it is given a location, and, frequently, especially with undisciplined minds, it is given a name also. And it is curious how seldom the names given to these centrally initiated feelings, represent any previous experience of the individual. The statement that she felt electrical currents coursing down her back, expressed the unknown rather than any previous experience. The most diverse sensations are as frequently described as electrical; and I have often inquired whether the person so describing had ever had electricity applied to her, and, in many cases, I find that she had not. Other expressions are even more frequently used to express centrally initiated sensations. For instance, a lady, the other day said that her head felt as if there was a vacuum in it. And another that she had a sensation in her throat as if water was flowing up through it. Indeed, the flowing of water down the back is a very favorite form of expressing sensations which cannot be compared to anything whatever. Feeling as if she was paralyzed is another favorite expression, used by persons who are especially liable to centrally excited ebullitions of energy by self-induced sensations.

Let us go back a little and again consider what "centrally excited sensations" are, psychologically

speaking. They are the memories of previous objective sensations. They are sensations which have been registered and are re-excited from within. They are the products of nerve-centres which have been permanently impressed by previous sensations from without. They are the combined tracts of all one's previous experience. They are traces of every sensation which has gone before, rising to consciousness. They are the results, in consciousness, of pulses of nerve-centres which are not complete exponents of any single or definite sensory impulse or combination of definite sensory impulses; but they are likely to be indefinite and wholly unreliable, unstable and shadowy memories of a vast number of previous sensations, arising into consciousness, under the stimulus of mental conditions, and should be so considered. Professor Alexander Bain says: "Our knowledge begins with difference; we do not know anything of itself, but only the difference between it and another thing." Some one else has said that "culture consists in increasing the power to see differences; and he is most highly cultivated who sees most differences." The first thing which any one claiming mental culture should see is the difference between objective and subjective sensations. In fact, the ability to appreciate this difference constitutes, mainly, the broad distinction between education—the possession of facts and ideas—and

culture, which is the ability to properly use them. We must always be on guard against confounding the sensations which proceed from stimuli acting from without and those cerebral pulses which are set up within. The danger is so great, that it is marvellous that so few seem to realize that the evidence of their feelings is not to be taken without careful questioning. If the direct evidence of our special senses cannot be depended on, as previously shown, how much greater must be the liability to error when conclusions are drawn from feelings depending on those pulses of nerve-force which have been set up in the cerebral end of the nervous system. And yet, large numbers of people take the evidence of their feelings, having nothing but an emotional origin, as evidence of bodily conditions. And the most serious part of it is that they also interpret the assumed evidence of their feelings by another set of emotional ebullitions. So that there are many persons whose ideas of their bodily conditions are the results of double pulses of centrally excited nerve-centres. An emotional temperament is simply one in which the pulse of action in the nerve-centres, rises higher than the occasion requires. There is a throb or explosion of energy under a stimulus which would produce only a pulse, in ordinary persons.

Æsthetic education, especially when not accompanied with special discipline, tends to increase in-

herited habits until the existence of some persons consists of successions of nerve-centre explosions—with all the prodigal waste of energy which accompanies that state—where mere pulses would answer much better. Such a person is thrown into ecstasies of pleasure or pain by causes by which a balanced temperament would not be affected. If a lady, she has a large variety of feelings, many of them disagreeable; and, if, for any reason, her attention becomes engaged with them, it is apt to become absorbed in their contemplation. If she has feelings along the back, she concludes she has spinal disease. If it is the head which disturbs her—and why should it not, with regular batteries of nerve-centre explosions, touched off by her own untrained and rampant emotions—she thinks there must be brain disease or something horrible there; the more horrible in name the better it will suit the particular ebullition which names the disease. There is seldom inquiry concerning the symptoms of spinal disease or brain disease; the inference being wholly subjective, the correspondence of symptoms to the disease named is not at all necessary.

There are multitudes of people in whom the centrally initiated sensations far exceed in number and violence those which arise from external causes. Such persons live under continual deception of their senses: that is, they have sensations which are as-

sumed to arise from peripheric sensory impulses, but which are mainly or wholly subjective explosions of energy, excited to action from within.

Educated persons should treat such sensations precisely as they do all other sensations—subject them to the crucible of question and analysis. When the young African walks forth at noon-day and sees an object following him which he does not understand, we do not so much wonder that he, in his blind ignorance, conceives his shadow to be a spirit of good or evil. And it will be good or evil according as some equally simple but to him incomprehensible, previous influence may have biased his mind. But for people, living in civilized communities, to accept mere mental impressions and treat them as unquestioned facts, would seem incredible on any other than the true theory that we are not very much civilized, after all. For the whole superstructure of the belief in the supernatural, the marvellous and the impossible consists in such acceptance of mere impressions in the place of facts, We see this credulity in regard to everything, especially when feelings are excited. But I speak more especially with reference to bodily conditions. And, happily, my personal experience covers an especially interesting class of cases, a class in which the error of accepting mental impressions, as evidence of bodily conditions, is well marked and easily dif-

ferentiated. And I give it as the result of a good deal of carefully guarded experience that there are hundreds of lame people walking about perfectly, who do not know that they ought to limp; and that there is a much larger number of persons who are either limping, walking on crutches or not walking at all, who have no affection whatever, causing lameness. For it is not the fact of a diseased joint, which, as a rule, causes lameness; but the degree of consciousness of an affected joint, which causes a person to favor it. And strange as it may appear to those who have no experience in such matters, it is not every one with a diseased joint who knows he is lame and favors it by limping. It continually comes under my professional observation, that certain persons do not seem to be conscious of an amount of disease, in a joint or elsewhere, which is sometimes capable, unless relieved, of causing loss of life. While others became hyper-conscious of the least variation from the normal state. And even when there is no disease whatever, there may be the feeling of disease, in consciousness. A young lady of seventeen came to me about ten years ago for what she and her friends supposed was disease of the hip joint. After examination, I told her that there was no disease of the joint whatever. I tried to explain to her comprehension that, for some reason, she had become anxious about the hip joint, and

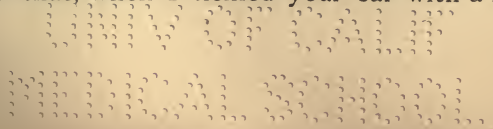
that her attention was so fixed on it that all sensations transmitted from that vicinity caused such throbs of the nerve-centres that an ordinary sensation was converted into an extraordinary one; and the anxious attention which she directed to that part, made her painfully conscious of what would, otherwise, be normal sensations and thus unnoticed. But I failed to impress her sufficiently to divert her attention from the part, and she continued to walk on crutches, in all, during eight years. At last she suddenly found that she was not lame. I had the pleasure of examining her, about six months after she had ascertained that she was not lame and I found a wholly unaffected joint, precisely as it was seven years previously when I first saw her. In this case, as in all others of a like nature, the difficulty is to be found in that condition of the cerebral nerve-centres which makes an ordinary sensory impulse to cause a throb of change in the nerve-cells, which resembles, in consciousness, what might occur from an extraordinary sensory impulse; as from a joint which is actually diseased. As the excessive action within the nerve-cells was due to subjective and controllable causes, the only possible remedy lay in disciplining the emotions.

The study of the relations of attention to consciousness and perception, is so important, and an understanding of those relations explains so many

things which would, otherwise, seem inexplicable, that I must add some further remarks and illustrations regarding them.

The principal point, which it is necessary to keep before the mind, is that we perceive or become conscious of events in a greater or a lesser degree, or not at all, according as the attention may be fixed on that or on something else. I cannot better illustrate my meaning than by relating a story which was told by my father, many years ago.

A gentleman went to the bank for a large sum of money. Receiving it, he put it in his pocket and placing his hand in the same pocket, directly on the package of money, went, as rapidly as he could walk, to his own office; but when he arrived, he found, to his astonishment, that the money had disappeared. Questioned by the detectives, who were immediately called, he declared most positively that his hand had been upon the money every moment from the time he left the bank until he reached his own office. The thief having been caught with the money on him, and confronted with the gentleman, the latter agreed not to prosecute (so the story goes) if he would tell him how he got it while his hand was on it. "Nothing could be more easy," replied the thief, "the position of your hand indicated where the money was. Your very intent to protect it so occupied your mind that, when I tickled your ear with a feather,



you did not know that you withdrew your hand to brush away what you supposed was a fly. Your very earnestness in struggling through the crowd, your rapid pace, and determination to convey the money safely, all were aids in holding your attention in the grasp of a vice, so that, after two or three efforts, I succeeded in extracting the money from your pocket, as your hand was withdrawn. But so fully was your attention taken up with one idea that you did not even recognize the difference, after the money was gone. And that is the way I did it. It was with your own unconscious assistance."

This little story not only illustrates the office of attention in relation to consciousness, but it shows how very easy it is to be mistaken concerning matters about which men are apt to be most positive. And, as in the story just told, nothing contributes so much to our deception, many times, as our own efforts, when they have not been previously trained in the same direction, to avoid deception. This is also abundantly illustrated in the case of inexperienced persons when attempting to fathom the supposed mysteries of so-called Spiritualism, Necromancy, and other proclaimed supernatural events.

Without attention there can be no consciousness. It is true that, in most cases, an ordinary sensory impulse is sufficient to arouse consciousness and perception. In general the effect, in consciousness, of

a sensory impulse is in the direct ratio of the attention in that direction, and in the inverse ratio of the attention engaged in other directions. This is as true of centrally as of peripherally excited sensations. Sir John Hunter said that he could produce a pain in his finger by thinking of it: that is, by merely giving his attention to his finger, to the exclusion of everything else, for the time being. My own experience satisfies me that such things more frequently happen than is generally supposed. My friend, Dr. Lewis Fisher, on returning from the country, several years ago, remarked to me that he had recommended a case to me, of a gentleman with an injured knee, who had consulted him, during the summer. At the time Dr. Fisher saw him there was some inflammation and swelling of the knee, for which he had prescribed; recommending, at the same time, the gentleman to apply to me for further treatment. He did so two or three months later, remarking that he had arranged his business so that he could remain in New York during the winter and that he should be perfectly satisfied if he could resume his business in the following spring. He had been injured during the preceding winter, along with several others, in coasting. He had been severely cut about the groin, which was supposed to be the extent of his injuries. But after six weeks' confinement and recovery from

the more obvious injury, it was found that the knee had also been injured—concerning which he had sought Dr. Fisher's advice. He walked with some difficulty and said he felt pain at each step. On examination, I found that, in the mean time, the knee had entirely recovered. By applying sufficient tests, I soon satisfied him that there was neither inflammation, soreness nor stiffness at the knee joint. In fact that it was perfectly well. Relieving him of his apprehensions—simply a form of attention—he no longer felt any pain and he could walk just as well as he ever could. In fact, he left for home within less than an hour after he had informed me that he had come to stay for the winter. The injury had necessarily fastened his mind on the affected knee; but the interesting although common fact is that he could not distinguish between sensations which were objective, while the inflammation remained in the joint, and the sensations which were subjective, after the disease had ceased to exist. Apprehension served to keep attention riveted to the part about which he was anxious, and this fact kept up such an excitable condition of the nerve-centres that they were sent off into continual ebullitions of energy, which rose in consciousness as pains and seemed to be continuous with those attending the inflammatory stage.

This case (which represents a large family of

similar cases) illustrates a remark previously made, that we do not remember pain as we do ordinary sensations. The condition producing pain ceases with its cure. Hence we can remember only the fact and circumstance of the event. The memory of the actual pain ceases to be possible with the cessation of the pain itself. But objective pain may call up or be the occasion for those subjective conditions which are constantly mistaken, in consciousness, for real pains. Thus we may have the objectively caused pains diminishing gradually with progress towards recovery from a condition producing pain, while there may be a gradually increasing subjective state which, in consciousness, resembles pain, but which is really a memory of the circumstances of pain heightened by the habit of the cerebral nerve-centres to be thrown into excessive action, which I have already dwelt upon. In such cases, the patient finds it impossible to distinguish between the objectively caused pain, the product of disease, and the subjective state, resembling pain in consciousness, which is wholly due to what may now, for convenience, be termed emotional pain. And it is the work of attention, in its various forms of self-observation, anxiety and alarm, (especially in certain temperaments) to establish conditions favoring emotional pains. The only possible cure for such pseudo-pains is the direction of

attention away from the feelings which tend to develop them. This is done very effectually, sometimes, by empirical practices, which, as may be inferred, do, so far as changing the subjects occupying the person's attention may go, have a scientific basis. The difficulty is that a disease is supposed to be cured, whereas the subjects occupying the attention in the form of fear, anxiety, apprehension, etc., have been changed. It is something which is constantly done by every intelligent doctor; though, it must be admitted that, not to claim mysterious power, divests the honorable practitioner of a large portion of his means of controlling the attention which quacks possess, in a certain class of subjects, because of their pretensions.

It is astonishing how completely the attention can be occupied under favorable conditions. A gentleman told me that he happened to be on a visit to the army when the battle of Williamsburg took place. In endeavoring to pass in the rear of the forces engaged, he met a soldier who inquired the way to a certain regiment. Stopping to give him the necessary information, he observed that one hand had been shot away. But when he called the soldier's attention to it he at first denied it and it was only by insisting that he should look for his hand, that he became aware of the injury. Here was an amputation, without anæsthetics and with-

out conscious pain, by the mere absorption of the attention in the progress of the battle around him. It is said to be the same very generally in sharp engagements: the participants are often oblivious to their injuries and only recognize them by results—the dripping blood, the failing strength, etc. On the other hand, cases like that given by Dr. Bennett, and that of Boutibonne, as given by Noble, and quoted by Tuke, are innumerable. A butcher, in trying to hang up a heavy piece of meat, slipped and was suspended on the hook. He suffered great agony when taken down and on being carried to the chemist his sleeve had to be cut away, because of the pain. But it was found that the hook had only penetrated his sleeve, the arm being uninjured. The story of Boutibonne is still more curious. It was at the battle of Wagram and men were falling all around him when he felt both his legs carried away by a cannon-shot. He sank down about eighteen inches and fell back benumbed by the shock. Having been told that hemorrhage was lessened by quietude, he remained perfectly still until the next morning, when the surgeons coming around, it was found that, instead of the legs having been shot away, the cannon-ball had ploughed a deep hole in the earth beneath his feet into which he had sunk, and that he was entirely unhurt. The number of like instances which might be quoted is unlimited.

Now these are not merely curious instances of exceptional perversions of sensations; but they represent extreme examples of phenomena which, in various forms, are common to all human beings. And very practical use can be made of the fact that sensations, of whatever kind, are not only mental but depend, for force and quality, on the actual present state of the mind. I remember a lesson that was taught me very early in my practice, which I have never forgotten and which has been of great value to me. It happened that I had a patient whose uncle was a surgeon of some eminence. There was occasion to perform a relatively small operation and, out of courtesy, I invited the uncle to do it. The patient was a feeble nervous little fellow, and between the mother's sobs and the uncle's roughness, the child was wrought up into a frenzy of excitement not only painful to witness but causing considerable loss of valuable time. It occurred to me that a better use of the time could be made in preparing patients, mentally, for an operation. And this is what I have ever since done. So effective has the mental management of patients been, in my experience, that I long since discarded the use of anæsthetics in the minor operations, such as tenotomy, opening of abscesses and the like, except in rare cases of badly spoiled children. One of the first cases on which I operated after the experience

above related, was that of a babe, only twenty-two months old—not old enough to understand language—so that I was obliged to control him by tones of voice and management. In the first place, no one was allowed to caress him or in any manner excite any form of emotion immediately preceding the operation, which was for club foot. Then the attendants were not only instructed but actually trained in modulating their voices to a quiet, soothing cadence. Every one was required to move carefully; and patience, as if we had weeks at our disposal, was strictly enjoined. The result was that there was scarcely an outcry at the cutting of the tendon. There was little calculated to fasten the attention on the foot as the seat or on me as the cause of the pain. So that when I returned, the next day, he held out his foot for me to inspect, as if nothing had happened. Taught by this experience, I have, ever since, made it a point to always regulate the mental condition, before an operation, and have found that, in the majority of cases, minor operations can be done with little pain and with no mental suffering whatever. In the first place, it is often necessary to eliminate or neutralize the influence of parents, in exciting their children's feelings, in response to their own emotions; which is not always an easy thing to do. To excite a child's emotions, by endearing words, caressings, presents and prom-

ises, toys and sweetmeats, is rather worse than a whipping as a preparation to bear an operation. But worse than anything else, is the deception which is so frequently practised on people, and especially on children, in reference to an operation. They always discount what is told them at a heavy percentage and their fears are excited generally far beyond the real occasion. There is but one way to treat a patient, and especially a child, and that is the manly way. If an operation will hurt, tell him so, no matter how young he may be. Justify his confidence in you by always speaking the truth. This will allay fear and he will approach quite a serious operation without anxiety or alarm. As a rule, children so managed, will express astonishment at the small amount of pain experienced. "Why," they often say, "I thought it would hurt more. I don't care."

Analysis of these procedures, shows that they are calculated to lessen the fixity of the patient's attention, and thus they actually lessen the pain which would, otherwise, attend an operation. For more than twenty years I have practised the mental anæsthetics—if I may be allowed the expression, —and I am positive that a physician, by careful management to that end, can diminish the actual pain and general suffering of patients, in proportion as such management is calculated to eliminate uncertainty, and thus enable the patient to "make his

mind up" to a definite conception through reason alone with small influence of emotion. And the best means he can possibly bring to bear is, in my opinion, to always speak the truth, the whole truth and nothing but the truth, under all possible circumstances of bodily ailment.

Recurring to the difficulty of distinguishing between objective and subjective sensations, I will remark upon the physiological reality of both, and especially that a knowledge of the fact that a sensation is rising in consciousness without the object, does not necessarily prevent the occurrence of such a sensation. The most that such knowledge can do is to prevent the deception of our judgments. The mental images—which are continually forming in all minds, visual and auditory, most frequently—are only feebler forms of the visions which some persons frequently and many persons occasionally have. The works of writers on mental phenomena abound in striking illustrations of these forms of purely subjective construction. They are a part of our daily mental life. As illustrating the fact, above alluded to, that we cannot prevent them, even when recognizing their non-objective origin, perhaps I cannot do better than to relate an incident which happened to myself, many years ago.

It is thirty years, since—for reasons which it would not interest you to relate—I found myself, one night,

alone in the middle of one of the then almost unbroken prairies of western Illinois.

After some hours' wandering, I realized that I had lost my way. I was accustomed to crossing and recrossing the prairies, and such a feeling as fear never entered my mind. The worst that could happen, was to remain on the prairie till morning. But my wife expected me; my young wife, who had left her home in the east and had gone with me to what was then the "far West," would be anxious about me. Hence the excited feeling which was the preparation for events which followed. In her anxiety I thought she would divine the cause of my delay and would send the sons of the gentleman, at whose house we stopped,—two stalwart western fellows—in search of me. I reasoned, what could be more certain? Then I listened. There was not a sound to break the utter deadness of the night air. Not an insect stirred; not a rustle of a wild-flower's leaf smote the waiting ear. Then there was a sound. Yes, I was right, the Ward boys were looking for me. And as I listened, never was sound of galloping horse more distinct. Galloping horse? Why, there were two horses, with their riders. Then the sound died out. They must be crossing a stream. Yes. They come up on the hither side and are coming nearer. So I go back to meet them. But the sound dies away. Have they missed the track? No,

for at brief intervals I hear them as before. Now nearer, now further away. Now at shorter and shorter intervals and with more and more varying discrepancies until the thought arose that my senses had deceived me. So I began testing, as well as I could, the sense of hearing. And I found, even there, under the peculiar circumstances, I could hear galloping horses in any direction, by simply turning my attention and strongly wishing to hear that sound. That matter settled, I pursued my way, under the expectation, that, by going on I must come to a settlement. For, though still thinly settled, the country was filling up rapidly and houses would spring up, as if by magic, and farms were being put under fence and plough, in all directions. To my relief, about midnight, the moon came up, right in front of me. By its light I could see the grove of timber which had been my objective point lying far to the left and rear. It was too far, I thought, to turn back now. I would keep on, find a house (I reasoned that I had gone about far enough for that) and get directions for reaching my destination by a shorter way. And there lay, right in front and a little to the right, a newly made farm fence. It had been put directly across the travelled road, causing the latter to make a detour to the left to avoid it. That must be a New England man, said I to myself, no western man makes so well-ridered a fence as that.

But, as I approached it so that I could distinguish the different rails and many things in detail, I was surprised when it suddenly vanished from before my very eyes. And it did not return as the sounds of galloping horses had done. Was it possible, I questioned, that my senses had again deceived me, notwithstanding, warned by the previous experience, I had put myself on my guard? But so it was. There was no sign of fence or other evidence of human activity. And, relieved that this second experience had effectually cured me of any future sense-deception, I travelled on. By this time the light from the moon was sufficient to make my road and everything plain, as I went towards the new settlement, to which the road I had taken must certainly lead. It was a new road, as the easily destroyed prairie vegetation clearly indicated, and must terminate in that cluster of small board houses, which the increasing light of the moon and my nearer approach, enabled me to distinctly see. *This* time there was no mistake. It was a scattered settlement of some half a dozen houses, recently put up, as yet without fenced fields or even land ploughed in anticipation of next year's crop. Selecting the one nearest and a little to the left, situated on a slight elevation, I made my way towards it. I would inquire the way, borrow a saddle, for greater expedition to relieve a watching wife, and return, next

day, for the wagon. A light in the house, and at this hour! There must be sickness, I feared. Not to disturb them, I left my horse standing in the road and, bounding up the slight acclivity, I was almost reaching out my hand for the door-latch, when I saw—a scrub oak-tree, with a star shining through its branches! And the new settlement which my excited brain had built and peopled, had vanished! How I retraced my weary steps; how I arrived, towards morning and awakened a calmly sleeping wife and family, need not be related.

It requires but a slight exercise of the faculty of analysis to discover that the main elements in the production of a conscious sensation of hearing and seeing things which had no objective or real existence, a certain degree of cerebral excitement, accompanied by a certain degree of concentrated attention, was all that was necessary, and, these conditions the occasion supplied in proper quantities. It may be pertinent to inquire here, in passing, what more do we have in so-called Mesmerism, Hypnotism, Spiritual manifestations and Trance, than simply more extreme instances of concentrated attention, with its accompanying special cerebration? As the experience, just related shows, it is not sufficient to prevent subjective sensations from rising in consciousness as representatives of objective sensations, to know that they are not objective.

Given concentration enough, and enough susceptibility to the subjective influence, and the images may arise in consciousness, all the same notwithstanding we know their origin. It is often difficult and sometimes impossible to distinguish, in consciousness, between the one and the other. No one is to be blamed for being thus deceived, unless he determines that he will not take the means for verifying and correcting his impressions. And this is the conclusion to which we must come. It is not that we shall never be mistaken, in regard to things which we see and hear, or which we suppose we see and hear; but the lesson we should learn is that we must always be on our guard against mistakes and suspend judgment, be slow to conclusions, until we have had time to compare one sensation in consciousness with another sensation in consciousness, as well as for the nerve-centres to subside from what may be ebullitions or explosions of energy, obscuring the judgment, to more quiet pulses of action, which give time and a better basis for accurate conclusions.

It is a neglect of such precautions, as I have just referred to, among the masses, that makes them peculiarly liable to be deceived by their own sensations, variously acted on, and renders them so prone to fall willing victims to charletans, who are themselves sometimes equally self-deceived.

Among plain people what more simple, than to conclude, if one has a pain and another lays his hand over the place, and the pain disappears, that there has been some virtue passing from the hand to the part affected? There was the pain, the hand and the non-pain. A little analysis shows how complicated such an apparently simple matter may be. In the first place, there may be no cause of pain at the point referred to by the consciousness. A patient of mine, who lost his arm in the war, often feels pain in his fingers. That is, there is a throb of change in his nerve-centres similar to what he experienced when he used to hurt his fingers. So his fingers are referred to, in consciousness, as the source of the sensation. As he has no fingers, from which such a sensation could arise, the consciousness is clearly mistaken. Or, suppose one has fingers and that some condition in them causes pain. As pain is a matter of consciousness, he will not have pain if his attention is sufficiently preoccupied. For we cannot be conscious of two feelings at the same time. That is, the attention will be occupied by whatever sensation, whether objective or subjective, may be, for the moment, paramount. But a person, professing or believing himself endowed with power of healing, is very likely to engage a patient's attention, to the exclusion of even a sense of pain, in certain cases. Hence the supposed re-

markable powers of healing we hear of. The same faith (which is but another form of fixed attention) may exist with reference to medicines or anything else, occupying the attention, to the exclusion of the unpleasant sensation which preceded it. The thing done will thus pass for a curative means, when it simply changes the objects of contemplation. This may be temporary, or in some cases, it is more or less permanent, during which time the local condition may change for the better or worse, quite independently of the conscious feelings regarding the part. And I do not deny that a change of attention may exert and influence favorably to the establishment of a better condition. On the other hand, concentrating the attention upon certain parts, where certain diseases are, without proper discrimination, wrongly assumed to be located, the running to doctors, of whatever kind, good or bad, the getting so easily "cured" by each new remedy or new doctor, is well calculated to demoralize a person both mentally and bodily, and be the cause of actual sickness.

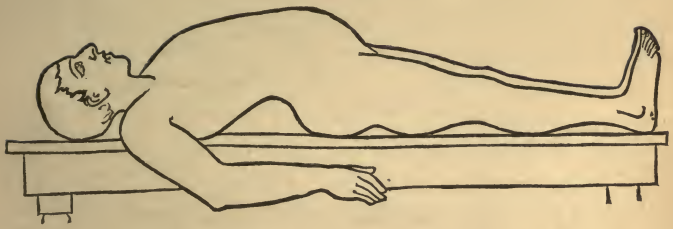
As an illustration of the ease with which an individual, and even a certain number in a community, may mistake appearances for realities, the following narrative is presented. About ten years ago I first heard of the alleged remarkable skill of an Italian peasant woman. Among others I was told of the

reduction of a dislocated hip joint in the case of a regular physician of this city, which, it was asserted, had practically cured him of a serious lameness which had afflicted him for many years. During the following year, I was visited by a near relative of this gentleman who partly confirmed the extent of the relief which had been afforded. Being curious to see for myself, I sent the gentleman an invitation to call on me, for the purpose of allowing me to make an examination. A few days afterwards, he very kindly called and freely and with perfect frankness related his experiences as follows: He said he had had dislocation of the right hip joint for twenty-seven years, or since he was a child. His leg was so drawn up and shortened that he had been obliged to wear a very high patten which, since his visit to Italy, he had been able to dispense with. He said that the process was this: after some days of applications of a kind of poultice to the hip, he had been laid on his back, on a table, when he was seized by the leg and knee and, by a dexterous but entirely painless movement, the dislocated bone was restored to its socket, and the limb brought down beside the other. When she commanded him to look at his feet, he saw, to his inexpressible delight, the feet beside each other, for the first time since his remembrance. Leaping from the operating table, he found he could walk with an ease and comfort which

he had never before experienced. His gratitude knew no bounds. Out of a sense of benevolent duty he had already taken several parties to Italy, all of whom had been substantially benefited by her marvellous skill. At my request, he submitted to an examination by Dr. T. M. L. Chrystie and Dr. William R. Fisher, who were in my office, and myself. The result of our examination revealed three facts; viz.: first, that the joint could not have been dislocated; for, second, it was firmly fixed (anchylosed) in the socket, and must have been so all the time; and, third, the union was with the thigh at about a right angle, so that there could not possibly have been any change, in position, at the time of the so-called "operation."

Now, it is not necessary to doubt the good faith and absolute sincerity, of either patient or peasant, in order to comprehend how a mistake could come about of supposing that something had been accomplished when, in reality, no change, whatever, had been effected. It may be asked, "How do I know that I was not mistaken?" It can be very easily demonstrated that I was not. I laid the gentleman on a table, and, without the least difficulty, and with no dexterity at all, I brought the foot of the affected side down beside the other; as is seen in Fig. 7.

Fig. 7.



A person with the right hip joint immovably fixed, at about a right angle with the pelvis, who believes motion has been restored to the joint by the manipulations of a charlatan: showing how, when lying, he brings his feet together by tilting forwards the pelvis and bending his back upwards, he, meantime, supposing the motion is at the hip joint.

But as you will also see in the same figure, to do it, I had to tilt the pelvis forward so as to curve the lumbar spinal column in a very large arch, as the figure shows. But when I attempted to bring the lower portion of the spinal column in contact with the table, I found it impossible to do so or to move it in the least degree in that direction, unless the thigh came up, in a corresponding degree and into nearly the vertical position, when he lay without any curve in the back, as is shown in Fig. 8. The same thing was true in his standing and

Fig. 8.

Same as preceding figure, and shows that, when his back rests naturally on the couch, the limb is drawn upwards, which would not be the case, if there were motion at that joint.

walking positions and movements. Under the impression that the position and use of the hip joint had been restored, he had discarded the patten which he had previously worn (to compensate for the shortening of the affected limb) and he then progressed in this peculiar manner: At times (evidently when his attention was on it) he would reach the lame foot to the ground by an evident effort, but always with the same extreme forward curve in the lower part of the back to which I have alluded. (Fig. 9.) At

Fig. 9.

The same as figure 7, but in the standing position. The position is maintained by an effort of the will.

other times (as when his attention was not engaged), his back would partly straighten, and then his knee would be drawn up and he would reach the ground by bending the knee of the well limb. (Fig. 10.)

Fig. 10.

The same person, as he walks when his attention is diverted, by bending the knee, of the unaffected limb, till the foot on the side of the rigid joint reaches the ground.

It may be asked, "How do you account for such a mistake in regard to the position of one's own limb?" It is easy enough, if we assume that, with his attention concentrated on the position of his feet, he did

not notice that the pelvis was tilted, in the manner described, in order to bring the feet together.* Likewise, under the excitement of a supposed change of position in the joint, he failed to consider (possibly did not know) that such a limb can always be placed beside the other by simply tilting the pelvis forward enough. All his movements afterwards took place under the impression that an alteration had been effected in the position of his limb, with the effect on his locomotion, above described.

As this case has been widely published and often referred to, during nine or ten years past, I do not hesitate to relate the facts of which I have personal knowledge, as one of the best possible illustrations of the purely subjective character of a certain class of cases, and the reasons why intelligent persons may have positive convictions concerning themselves which are not in accord with the facts.

There are two classes of persons who furnish the principal subjects for so-called, "bone-setters"—a class of persons which, like mesmerizers, mediums, necromancers, etc., could not exist except for the plentiful number of people who accept the evidence of their senses, without question.

They consist of those persons who, like the case above related, are affected in some way, and after

* In cases of anchylosis of one hip joint, the lower portion of the spinal column becomes very flexible.

certain manipulations, suppose themselves benefited, when they are not. And a still more numerous class who believe themselves affected with a disease or lameness, when they are not so affected. In both cases, they accept the evidence of their sensations and suppose that they are better because they are made to feel different. The self-deception is readily explainable. The cerebral nerve-centres are acted powerfully on, mainly through emotional attention, expectant attention, curiosity, hope and other forms of attention, until the feelings of which the mind was previously conscious, whether objective or subjective, are displaced and superseded by the newly acquired feelings. The person has acquired certain sensations which are pleasant, in consciousness, displacing others which were disagreeable. Hence, he thinks himself cured. That the affection which he had or supposed he had, has been benefited, is a mere conclusion.

And allow me here to say that I think it would better comport with the dignity of my own profession, if physicians would take a more philosophical view of such facts as I have related, and, instead of being annoyed, should study to know the philosophy of delusions of every kind. It will thus be found that the cause lies deep in the nature of sensory existence, and that the remedy can be found only in a higher culture, which must include a better

knowledge of what really constitutes sensation and pain.

The central ideas, in the foregoing presentation, may be summarized as follows: Conscious sensation, whether objective or subjective, is a mental act. A sensory impulse becomes a conscious sensation only by producing a display of energy in the cerebral nerve-centres, or brain, of a certain, or cognizable degree of force; and then only when the attention is not engaged with other relatively paramount sensations. Attention, occupied with one sensation, excludes other sensations, while thus occupied. Single sensations give no knowledge, whatever, of objects acting on the senses. Multiplied sensations leave traces which are recognized, in consciousness, as belonging to the same or to different or to compounded sensations; and, hence, there is formed the sense-judgment, or conclusion, a memory identifying or comparing one sensation with those which have preceded it. Hence, sensations, except the first, are never single, but are always compounded of those exciting and those which are excited. At first, the primary or exciting sensations are objective, the responding ones, subjective. But soon the faculty of subjectively exciting other subjective sensations, is acquired; when perception becomes still more complicated, and liable to error. There is no way of distinguish-

ing between objective and subjective sensations, except through an act of the reason: which is another way of saying, that we must wait before allowing a conclusion to be formed. A hasty judgment, in regard to any feeling, is likely to be erroneous. Pain is different from ordinary sensation in that it requires an abnormal condition for its production, and that it cannot be produced without such abnormal condition. Hence, it is impossible to remember pain, because the apparatus does not exist for causing such a sensation as pain, after the fact, or when it is to be remembered. Memory is a repetition, in the nerve-centre of energy which was first caused by the sensory impulse from without. But centrally initiated sensations may be mistaken, in consciousness, for pains; depending wholly on a certain intensity of excitability in the cerebral mass. But here again reason, or slowness in arriving at conclusions, is able to differentiate between actual and mistaken pains, and thus to resolve the latter out of existence.

The savage or primitive man, accepts the evidence of his senses in all things, without question. The first step, in man's progress upward, is the beginning of questioning. To recognize one's limitations is to over-leap them. And the highest evidence of culture and progress is to be able to suspend judg-

ment regarding every thought and feeling, while submitting them to the arbitrament of unbiased examination.

NOTE. *The following authors were consulted before preparing the foregoing paper: Carpenter, Bain, Herbert Spencer, Bastian, Maudsley, Tuke, Huxley, Galton, Dalton, Orton, McCosh and Noah Porter.*

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