Two Lectures

ON THE

PHYSIOLOGY OF THE EMOTIONS.

DELIVERED AT KING'S COLLEGE,

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LECTURE I.

WHEN my friend Professor Hallibarton asked me to give two lectures on the physiology of the nervous system, I bethought myself what subject of importance to the medical student was not already fully and adequately dealt with in his lectures or in his admirable textbook.

I am not surprised that the physiology of the emotions occupies but little space in our standard textbooks of physiology, for its study in animals by experiment has been in a great measure unfruitful or open to criticism. Yet French and Italian physiologists have successfully devoted much attention to the subject, and the experiments of Professor Sherrington are of great importance in this connexion. I wish also to acknowledge my indebtedness to the philosophical works of Dr. Henry Maudsley on the physiology and pathology of mind. Then no consideration of this subject is complete, especially from the biological aspect, without a study of Darwin's great work on the *Expression of the Emotions* and the classical work of Sir Charles Bell on the *Anatomy of Expression*.

Let me preface my remarks by saying that I am not so foolish as to suppose that I can do more than expound some of the facts of anatomy and physiology, with a direct or indirect bearing upon the psychology of the emotions, for there is probably no subject in the physiology of mind of which we know less. Yet its study is well worthy of attention, for it will serve you in good stead in understanding the neuroses and psychoses in which emotional disturbances are usually an important and even essential feature.

The physiology of the emotions finds its expression in the language of the novelist, the poet, and the dramatist. Thus Spenser in his *Fairy Queen* says:

And troubled blood through his pale face was seen
To come and go with tidings from his heart.

Clarence says to his murderers:

How deadly dost thou speak!
Your eyes do menace me: why look you pale?

As the emotions are depicted in their writings, so the measure of their success may be gauged. The interest aroused and the emotional echo awakened in ourselves is the response by which we share the feelings and motives of the characters portrayed. Again, popular metaphor illustrates the physiology of the emotions: "The broken heart," the "light-hearted," "breathing out vengeance," "bowed down with sorrow," "the breast swells with anger," "blue funk," and the coarse expressions used to denote paralysis of the sphincters in fear, and many other examples, will occur to you.

According to Ribot¹ the emotion is in the affective order the equivalent of the perception in the intellectual order: a complex synthetic state which is composed essentially of movements produced or arrested, of organic modifications in the circulation, respiration, etc., of a state of consciousness, agreeable or painful or mixed, proper to each emotion. It is a phenomenon of sudden appearance. It is of limited duration. It certainly may not be of limited duration in the case of sorrow, which generally is contemplative, whereas grief is tumultuous and less persistent. Ribot should have stated: It is of *limited duration* in the primitive forms as manifested in animals, in the child, in the imbecile, and in the savage. It is related always to the preservation of the individual or the species directly for the primitive emotions, indirectly for the derived emotions. By primitive emotions I mean anger, fear, joy and sorrow, disgust, and the tender emotions, love, sexual instinct and reciprocal affection of mother and offspring.

An object or idea excites an emotion; thus a stranger suddenly intrudes himself into your presence, producing an emotion of anger or fear, preceded by momentary astonishment. The *objective* manifestations of the emotion

you are experiencing may be slight, transitory, merely a flush or pallor; and a slight alteration of expression may be all that is obvious to the stranger; but if the emotion be not controlled, then all the outward bodily manifestations of anger and fear may occur. In both cases, however, there are internal organic disturbances.

Let us consider the emotion Fear, and I will borrow from the description by Darwin. Fear is often preceded by astonishment, and is so far akin to it that both lead to the sense of sight and hearing being instantly aroused. In both cases the eyes and mouth are widely opened and the eyebrows raised. The frightened man at first stands like a statue, motionless or breathless, or crouches down as if to escape observation. The heart beats quickly and violently, so that it palpitates and knocks against the ribs (due to *accelerator sympathetic excitation*); but it is very doubtful if it then works more efficiently than usual, so as to send a greater supply of blood to all parts of the body, for the skin instantly becomes pale, as during incipient faintness (due to *vasomotor spasm*), a cold sweat occurs (probably excitation of sympathetic and constriction of involuntary fibres in sweat glands) the hairs are erected (goose-skin, or pilo-motor contraction), and the superficial muscles shiver (due to coolness of the skin).

The salivary glands act imperfectly, the mouth is dry* and is often opened and shut. The pupils are dilated (stimulation of dilator fibres). We see that in fear there is a profound effect on the sympathetic vasomotors supplying the unstriated muscle fibres of the vessels, and in terror the effects are more pronounced. In anger there is an exactly opposite effect; dilatation of the vessels, flushing of the skin, warmth, perspiration, and increased muscular tone and action. It seems as if there were an antagonism between the action of the unstriated muscle and the striped, except that in fear there is relaxation of the unstriated muscles of the sphincters and loss of visceral tonus.

"There are two theories advanced to explain the emotions; according to the one, they are derived qualities, modes, or functions of consciousness; they only exist by it. This is the *Intellectualist theory* which has found its more complete expression in Herbert and the German School of Psychology, according to which every affective state only exists by the reciprocal relation of representations; every feeling results from the co-existence in the mind of ideas which support or antagonize it; it is the immediate conscience of elevation or depression of psychic activity, of a state of free or restrained tension. Suppress every intellectual state, and feeling vanishes. The other, the *Physiological theory* of Bain, Spencer, Maudsley, Lange, James, Sergi, and Ribot, connects all affective states to biological conditions, and considers them as the direct and immediate expression of the vegetative life." According to this physiological theory, the emotions have their roots in the instincts, appetites, and desires. In contradistinction to the Intellectualist theory, we have the peripheral theories of James, of Lange, and of Sergi, that emotions follow upon and are the result of organic changes; whereas the Intellectualist theory is that the perception or idea produces the feeling of the emotion which is followed by the organic changes. There are three peripheral theories. Let us consider the simplest first, that of Lange. It comprises two propositions: (1) The psychic emotion does not exist, but is only the state of consciousness brought about by organic disturbances. (2) The reflex organic disturbances which are the factors of the emotions are themselves only reflexes of the circulating apparatus governed by the vasomotor centres. This is therefore termed the *Vasomotor theory*.

Sergi has opposed this theory and has asserted that it is too restricted, and he would include not only the vasomotor centres, but also all the bulbar centres, including the respiratory, and the centres of vegetative life; hence Sergi's theory is termed the *Bulbar theory*.

Physiologically considered, Sergi's arguments that the other bulbar centres should be included are strong, because we know that the *vasomotor* and *cardiac* inhibitory centres have phasic periods of activity and relaxation corresponding to those of the respiratory centres. The centre of deglutition reacts also very manifestly upon the respiratory and the cardio-inhibitory centres in

*The vaso-constrictors of the salivary glands are post-ganglionic from the superior cervical ganglion.

man; the pulse is quickened during deglutition; there is on swallowing a short inspiratory twitch of the diaphragm, followed by an arrest of impulses from the respiratory centres.

All the bulbar centres must be associated for the perfect performance of the vital functions of nutrition, of respiration, and of circulation.

Again, we know that the pneumogastric is the great nerve of organic life, controlling the actions and secretions of the viscera, and very possibly the metabolism of the body. We know that puncture of the fourth ventricle produces glycosuria, and therefore disturbs either the liver or the pancreas in its functions. Again, in the bulb we have the motor cells which preside over the muscles of expression, speech, and vocalization. The pons and medulla represent a complex of spinal segments; we know that in the simple spinal reflexes the same groups of muscles are brought into play to give rise to totally different purposive actions, according to the nature of the stimulus. This means an integrative or associative action of these spinal segments; the same integrative or associative action of the infinitely more complex centres in the medulla takes place under appropriate stimulus, as I shall hope to show you later. There is much, therefore, to be said in favour of the whole of the structures of the pons or bulb being primarily affected in an emotion, as Sergi asserts.

Lastly, we have the more complex theory of James that emotions follow upon the bodily expressions—the *coarser emotions*, at least. He says our natural way of thinking about these coarser emotions is that the mental perception of some fact excites the mental affection called the emotion, and that this latter state of mind gives rise to the bodily expression. His theory is not this—the intellectual theory—but that the bodily changes follow directly the perception of the exciting fact, and that *our feeling* of the same changes (as they occur) is the emotion. He points out in support of his theory that every one of the bodily changes, whatever it be, is felt acutely or obscurely the moment it occurs.

If we fancy some strong emotion and then try to abstract from our consciousness of it all the feelings of its bodily symptoms, we find we have nothing left behind; no mind stuff out of which the emotion can be constituted, and without the bodily states following on the perceptions, the latter would be purely cognitive in form, pale, colourless, destitute of emotion and warmth.

One objection raised to the peripheral theory is that people state they do feel the emotion—for example, *fear*—before the bodily manifestations occur. Yet, if they are questioned about this, they say it is very difficult to decide; and when you ask them when they know that the sense of, say, *fear* has departed, they tell you that it is only by the feeling of the organic changes having left them. In fact, can we summon up in the mind the feeling of an emotion and at the same time suppress all bodily manifestations? A case recently came under my notice: A highly intelligent man suffered with cerebral tumour; he suffered with curious attacks which he described as follows: Suddenly a sense of fear, associated with pallor, momentary arrest, disturbance, or weakness of the action of the heart, disturbance of respiration, trembling and weakness of the body and limbs, a feeling of anxiety, suffocation, and vague unpleasant sensations in the breast, also dryness and an unpleasant smell or flavour in the mouth. When I asked him how he knew the sense of fear had gone, he said it was only by the return of the normal *organic* sensibility, as shown by the departure of the disturbances described.

Here, then, was no doubt some source of excitation in the cerebrum which gave rise to these curious attacks; but functional conditions of a similar character have been described by James, and more recently by Sir Wm. Gowers. James says that pathological cases in which the emotion is objectless furnish the best proof that the immediate cause of emotion is a physical effect on the nerves, and he cites a case in point in which the individual suffered from attacks of inability to draw a deep breath, fluttering of the heart, precordial anxiety with an irresistible tendency to take a crouching attitude and to sit still, accompanied, perhaps, by other visceral disturbances occurring quite spontaneously. I have seen such a case. The patient's feeling of this combination is the emotion of

dread, and he is the victim of what is known as *morbid fear*.

Sir William Gowers, in his recent very interesting work on the borderland of epilepsy, describes somewhat similar cases, which he terms "*vagal and vaso-vagal attacks*." They were described by Nothnagel as "*angina vasomotoria*," and also by Sir Douglas Powell. Some of the symptoms were classed by Bonnier as "*syndrome médullaire*," but none of these writers have brought the symptoms together as features of definite attacks irrespective of their relation to the heart.

As far as I can gather from the account of the cases given by Sir William Gowers, they came on independently of any particular state of consciousness which would give rise to morbid dread or fear; yet, as in James's case noted, "there may be a sense of vague fear and dread which is recognized to have no adequate cause."

The vagal symptoms are chiefly referred to the stomach, respiratory system and the heart. We may probably ascribe to the gastric nerves a sensation referred to the epigastrium, generally described as a sense of oppression or of fullness, but often indescribable. It begins suddenly, irrespective of the state of the stomach or of its functions, and often seems to ascend to the chest, very seldom to the throat or head, as does the aura of epilepsy. There is seldom nausea and never vomiting. Even more common (especially as an early symptom) is a sense of respiratory distress, or difficulty in breathing; the cardiac symptoms are discomfort (in some cases acute pain), and often a feeling of arrest of the heart's action. It causes alarm; but, apart from any cardiac sensation, there is sometimes a vague feeling of fear and dread, which is recognized to have no adequate cause. The slowness of mental operations, the difficulty in thinking or in concentrating attention which may accompany these attacks, or may even be the first symptom, is probably owing to the same cause as pallor of the face and coldness of the extremities, and is related to vasomotor spasm and inefficiency of the heart's action.

According to James, objects excite bodily changes by a pre-organized mechanism; the changes are so indefinitely numerous and subtle that the entire organism may be called a *sounding-board*, which every change of consciousness, however slight, may make reverberate. Even if James's theory cannot be accepted in its entirety, there can be no doubt that what he says is true, that without these organic bodily disturbances—the result of a diffuse discharge of nervous energy—there would be a colourless feeling, and the emotion, if it existed, would be disembodied.

Ribot points out that Maudsley had already, in his *Physiology of Mind*, indicated this peripheral theory without insisting upon it too strongly. He quoted Burke in his treatise *On the Sublime and Beautiful*:

I have often observed that, on mimicking the looks and gestures of angry, or placid, or frightened, or daring men, I have involuntarily found my mind turned to that passion whose appearance I strove to imitate.

Burke also writes of the physiognomist Campanella:

When he had a mind to penetrate into the inclinations of those he had to deal with, he composed his face, his gestures, and his whole body into the exact similitude of the person he intended to examine, and then carefully observed what turn of mind he seemed to acquire by the change. Thus he was able to enter into the dispositions and thoughts of people as effectually as if he had been changed into the very man.

Darwin in his great work on *The Expression of the Emotions* supports the view that the assumption of the facial expression and attitude of an "emotion gives rise to the *feeling* of the emotion"; but Maudsley points out that there is a fallacy in making this experiment, for in order to produce the suitable movements of expression we are compelled unconsciously to imagine the emotion. The practised actor, however, does not necessarily feel any emotion. Probably Maudsley's position is the correct one when he asserts:

In our emotional life any particular passion is rendered stronger and more distinct by the existence of those bodily states which it naturally produces, and which in turn, when otherwise produced, tend to engender it.

Darwin says: "Most of our emotions are so closely connected with their expression, that they hardly exist if the body remains passive."

It seems to me probable that the bodily feeling of the emotion intensifies and prolongs it, meeting the idea half

way. In fact, an emotion cannot be looked upon as a physical entity, and it would be better to leave out the insoluble question of which is *cause* and which *effect*, and assume that no conscious state is capable of dissociation from its physical conditions.

Dr. Claye Shaw recently wrote a paper in *Mind* in which he calls attention to the question of actors *feeling emotions*, and he was good enough to introduce me to Mr. Comyns Carr. This gentleman informed me that actors do *not* feel the emotions which they so skilfully portray; in fact, if they felt an emotion, for example fear, they would be unable to perform their parts. Thus the art of acting lies in concealing the art, and the actor, by his expressions and gestures and the modulations of his voice, feeling himself no organic internal disturbance—the essential part of an emotion—can nevertheless, by his art, arouse in the expectant audience that part of an emotion which he does not portray, namely, the quickening or slowing of the pulse and respiration, the emotional thrill or shudder of the spine, pallor and coldness, or redness and warmth of the skin, and various other manifestations of diffuse visceral-vascular disturbances.

James quotes William Archer on the anatomy of acting in support of his theory, and certainly some actors and actresses do *feel* these internal disturbances. Especially do they refer to emotional disturbances when performing the part of Othello. It evidently depends largely upon the temperament of the individual actor, for Forbes Robertson writes:

I suffer from fatigue in proportion to the amount of *emotion* I have been called upon to go through, and not from physical exertion.

Professor Sikorsky of Kiev contributed an important article on the facial expression of the insane to the *Neurologisches Centralblatt* for 1877, in which he says:

When I contract my facial muscles in any mimetic combination I feel no emotional excitement, so that the mimicry is in the fullest sense of the word artificial.

So with "quick-change artists"—they cannot feel any emotion. But habitual acts such as these may become unconscious, and a certain amount of feeling of the emotion when the mimicry is first practised may soon become vague and lost.

Two fundamental biological principles—the preservation of the individual and the preservation of the species—are the basis of all vital actions in the animal kingdom. In all animals, consisting of a commonwealth of cells composing organs and tissues, different in structure and function, harmonious co-operation by which the animal is able to adapt itself to environment is brought about by two vital processes—namely (1) a biochemical association, by means of the circulating blood and lymph, which contains the products of the vital activities of all the cells; and (2) a biophysical association, by means of the nervous system. These two associations are similar in plan in all mammals, yet there are differences to each order, to each species of the order, and to every individual of each species. The similarity is shown by the reaction to conditions which produce pleasure or pain in the struggle for existence and survival of the fittest, and in the manifestations of the primitive emotions—anger, fear, disgust, and the tender emotions, courtship, the sexual instinct, and the reciprocal instinctive sympathy of parent and offspring.

The sense of wellbeing of the whole personality of the individual depends upon an adequate supply of blood to each and all the important tissues of the body, whereby they can function in harmonious co-operation. This in a healthy individual is the prevailing bodily condition, and a general pleasurable satisfied sense of wellbeing is the result of this harmonious co-operation. The quality of the blood, by its influence on the nervous centres, may affect the emotional reaction, for we know that toxic conditions of the blood have a profound influence on the affective state of the individual.

We have definite evidence that the respiratory centre in the medulla is sensible to the chemical condition of the blood as regards the amount of oxygen and carbon dioxide it contains, and when all afferent channels are cut off the centre is capable of automatically responding to the chemical changes. "The activity of the centre is intimately dependent on the condition of the blood, and is

especially excited by increased vascosity of the blood or allayed by improved arterialization" (Starling).

Again, we have evidence to show that the internal secretions of glandular organs may excite or arrest tissue activities even without the influence of the nervous system; there are other secretions—for example, adrenalin—which excite through the sympathetic the viscerovascular motor system; again, the profound effect upon the mind of the early removal of the reproductive organs has long been known, and gave Brown-Séquard the idea of the importance of the internal secretions of organs. Nothing is more obvious than the intimate association of the emotions with the reproductive organs and their functions, and this association may be partially due to an internal secretion passing into the blood, arousing instinctively characteristic feelings in a preorganized complex nervous mechanism which in the long procession of ages has habitually acted and reacted in the same manner; there has thus been established a biochemical associated memory in the seat of consciousness of the presence in the blood of a substance indicating tumescence of the gland and the desire of detumescence. I do not mean to assert that the sexual instinct and the emotions associated therewith may not be aroused by nervous stimuli proceeding from the turgid gland and the seminal vesicles, but inasmuch as the sexual desire and instinct is more persistent when the glandular substance is left behind, although its connexions are severed, than when the glands are entirely removed or destroyed; and since we know from other experimental facts* that the internal secretions can serve as messengers to remote parts when all nervous connexions are severed, we may conclude that the complete mental revolution which takes place at puberty may be of twofold causation—biochemical by the blood, and biophysical by the nervous system. The ancient Greeks ascribed the diversity of temperament to the mixture of the elements of the body, and more to the fluids than the solids. In every succeeding age the distinctions of constitution and temperament have been attributed to the humours. Hippocrates treated of four radical humours—the sanguineous, phlegmatic, choleric, and melancholic. Recent discoveries in biochemistry indicate that the humoral theory is in a measure true, but it is inseparable from the cellular theory; for upon the quality of the blood depends the healthy condition of all the organs of the body. Now we are only conscious of the internal organs when some disturbance of their normal activity occurs—alteration of the rhythm, alteration of their phasic or periodic activity, or some disturbance of their function, temporary or permanent. This organic sensibility produces a disturbance in consciousness when the normal impulses from the vital organs are altered. Normally of low intensity, diffuse and uniform, it only produces a vague effect upon consciousness; but this coenaesthesia is the great silent background of *personality*, and as Maudsley so truly remarks:

It may well be that the general uniformity of passions and desires among mankind is owing to the uniform operation of the bodily organs upon the brain, and just as the general uniformity of their ideas is owing to the uniform action of the organs of the senses.

Coexistent with the progressive evolution of the animal kingdom is found an increasing development and complexity in the respiratory, circulatory, and nervous systems, especially the latter, and the upward steps are marked particularly by the increasing development of the nervous system. In the developing embryo we find an abstract and brief chronicle of the phylogenesis of these systems. The muscles and glands to which the nervous system in response to stimuli discharge innervation currents require a due supply of blood according to the intensity of their activities. In order that these systems—respiratory, circulatory, and nervous—may co-operate efficiently, muscles, glands, organs, and subcutaneous tissues, etc., must automatically receive a supply of blood in proportion to the intensity of the innervation currents, the emotions excited and the energy expended. Again, the grey matter of the central nervous system when discharging more energy must receive automatically more blood if it is to maintain its potential equilibrium. The vasomotor system is therefore brought into harmonious

* Paul Bert divided all the nerves to the mammary gland of a she-goat; the mammary gland nevertheless developed during gestation.

co-operation with the central nervous system which directs and controls the expenditure of muscular and glandular energy. The principal vasomotor centre is in the floor of the fourth ventricle, but in the thoracic region of the spinal cord, where the primitive metameric segmentation persists, there are vasomotor centres which give off the fine medullated fibres passing to the ganglia of the sympathetic—vertebral and paravertebral.

Now the study of the emotions would seem to show that there is some sort of antagonism between the discharge of innervation currents into the striated muscles entering into the life of relation and the unstriated muscles of the arteries; for in emotions such as fear, disgust, grief, we find evidence of vasomotor constriction as manifested by pallor of the skin, goose-skin, cold feeling, cold sweat, dry mouth, associated with enfeeblement and loss of tone in the skeletal muscles; whereas in anger and joy there is relaxation of the unstriated vaso-constrictor fibres with a dilatation of the vessels, flushed skin, associated with glandular activity and increased muscular activity.

It is obvious that increased muscular and glandular activity requires automatically an increased supply of blood; it might be argued, indeed, that the increased activity was due to impulses from the brain affecting the vasomotor system as well as the centres which innervate the striped muscles—the two systems being associated by inhibition of the one and impulsion of the other.

It is probable that under certain conditions stimuli may travel down the posterior roots inhibiting vaso-constrictor influences. For Bayliss has shown that there are no vaso-dilator fibres to the hind limb of the dog, in the abdominal sympathetic chain, but the only fibres excitation of which will produce dilatation are contained in the posterior roots. But the facts of degeneration show that the posterior roots do not contain efferent fibres. Bayliss, therefore, comes to the conclusion that the same nerve terminations in the periphery serve both to take up sensory impressions and to convey inhibitory impulses causing dilatation of the vessels. In this way we can understand how increased innervation currents to muscle would automatically be associated with vaso-dilation and increased flow of blood to the parts actively engaged in using up energy, and therefore requiring more arterial blood.

The affective tone of the individual largely depends upon the influence of the vasomotor and vagal nerves; it is continually oscillating about a mean point of equilibrium, a mental state that is neither painful nor pleasurable. Although neither pain nor pleasure can be said to constitute an emotion, yet one or other, and sometimes both, form an essential part of every emotion. We know little of the physiology of pleasure; it is a diffuse vague state of consciousness clothed and enriched by perceptual and intellectual associated memories which we desire to experience again, and it forms an accompaniment of the healthy activity of bodily functions which does not exceed the ordinary normal powers of reparation that the organism possesses. The fundamental basis of the stimuli to this activity of bodily functions is the satisfaction of the desires, appetites, and instincts necessary for the preservation of the individual and the species. The preservation of the individual, however, depends not only on the maintenance of the nutritional equilibrium by the gratification of the appetites, but the body is protected from physical and chemical injury by pain and the unpleasant experience of disgust. These are both states of consciousness which there is no desire to experience again, and when clothed and enriched by perceptual and intellectual memories, their causes can be avoided. Thus, by constantly furnishing the desire to prevent painful and injurious bodily conditions, they form, even more than pleasure, the basis of voluntary action. In the animal scale at first, they form only psychical adjuncts to protective reflexes, but they come more and more to dominate automatic instinctive reflex activities which only arise consecutive to the injury. Besides physical pain, many painful states may be related to the organic needs of hunger, thirst, the desire for sleep, for exercise, and repose, muscular fatigue, and the non-gratification of the sexual instinct. But besides these physiological cravings we may have artificial cravings—for example, for alcohol, tobacco, morphine, etc.; and any interference with the habitual routine of life may cause discomfort. In fact, the sentient being, whether animal or man, reveals a complex of desires, of appetites, and of physical and

psychical tendencies, and all those conditions, whether from internal or external causes which suppress or interfere with them, give rise to painful states, physical suffering and mental pain.

Let us now consider the more simple physical pain, though even in this question there are still many points in physiology not definitely settled; for example, Is there sufficient evidence to warrant us in accepting the existence of special pain nerves, or is pain merely the result of injury by strong excitation of the nerves of general sensibility? It is known that pressure of a point of the skin just short of the breaking point causes pain. Heat of 48° C. causes a painful sensation; this is the temperature which causes changes in the nerve substance. The cornea, which is a delicate skin where the nerve fibrils are almost naked, is extremely sensitive to slight irritation. Painful sensation depends, however, not only upon the intensity of the irritant, but also upon the irritability of the chains of neurones which form the sentient system of receptor, transmitter, and perceptor. This is a matter of common experience, especially in disease. Pain is felt in the cerebrum, and without the cerebral centres there would be no pain, only irritability and reflex discharge such as occurs in a decerebrate animal. We only remember physical pain by the perceptual concomitants that caused it or were associated with it. Whilst visual, auditory, tactile, gustatory, and olfactory impressions are referred to the external objects which produce them, the pain of pricking, cutting, and burning are not exteriorized into the needle, the knife, or the flame. Cutaneous sensibility to pain is associated, therefore, with the internal organic sensibility; it is precise enough as to localization, because in its prevention it is continually associated with perception of the special senses. The prevention of pain serves thus as a constant factor in the development of the special senses. The same cannot be said of pain affecting the internal organs, but, according to a physiological law depending upon morphological conditions, the mind refers the pain to a definite area of skin, and this pain is termed a "referred pain." Thus in angina pectoris, where there is irritation of the cardiac plexus, not only is there a state of precordial anguish, of constriction, and feeling as if the vital functions are about to be suspended, but a pain which radiates from the chest down the inner side of the left arm. This referred visceral pain can be explained by the fact that the afferent fibres of the cardiac branches of the sympathetic enter the same segments of the spinal cord as the sensory cutaneous nerves of the post-axial border of the upper limb corresponding to the distribution of the ulnar nerve from the lowest cord of the brachial plexus. The visceral-vascular structures are supplied by the fibres of the white and grey rami of the sympathetic, and strong irritation of internal visceral structures produces intense impulses which are carried by afferent visceral fibres into the grey matter of the various segmental metameres of the spinal cord; these by irradiation excite the neurones which receive painful stimuli from the associated skin areas; the result is twofold, the establishment of a protective reflex by contraction of the associated groups of skeletal muscles and a painful sensation transmitted to the seat of consciousness. The mind is only cognizant by the senses of this particular painful stimulus coming from a definite skin area; it therefore refers the pain to it. Thus the establishment of the protective reflex serves to keep the parts at rest and the pain produced protects the internal organ by preventing that reflex being broken down by volition.

REFERENCE. 1 *Les Sentiments.*

THE First International Congress for the Repression of the Adulteration of Alimentary and Pharmaceutical Products will be held in Geneva in September, 1908. The feeling that such a congress is necessary has been growing for a quarter of a century, and at the Fourteenth Congress of Hygiene and Demography, in Berlin, 1907, the Universal Society of the Geneva White Cross conceived the idea of initiative action. The plan for the first meeting is an exhibition of unadulterated products, and the aim of the Congress will be to arrive at a definition of unadulterated food—in fact, the establishment of a "Codex alimentarius." The Committee of Organization is anxious that manufacturers, chemists, and lawyers who are interested in this question should unite in formulating these definitions.