The Significance of the Conditioned Reflex in Mental Hygiene

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THE main facts in regard to the investigations of the conditioned reflex are now familiar to psychologists and psychiatrists, or in any case literature in regard to them is easily accessible (7). The history of these studies need not be recounted; but the significance of the results for mental hygiene is not yet generally understood. The purpose of this paper is merely to suggest that many important educational and hygienic subjects are most clearly understood and perhaps most profitably investigated from the point of view and by the method of the conditioned reflex.

The importance of the scientific method is fortunately recognized in mental hygiene as well as in somatic hygiene; and as regards the method of the conditioned reflex, the great advantage of it lies in the fact that with this method one’s feet are on the solid ground of scientific fact while unusual and mysterious problems are studied. Even if at present one’s results are meager, the student has at least the advantage, to his own personal mental health and to the healthful development of scientific hygiene, that comes from the use of scientific methods in any subject; and the results have a well established value because they can be verified by any competent investigator who can repeat the conditions. The question may well be raised whether one of the first important things is not to determine how far the problems of mental hygiene may be explained by a few of the very simple fundamental principles of scientific psychology.

Theoretically, two great epochs in the development of the brain and mind can be distinguished. First, the development of the new brain, the neocortex, or the brain cortex and...
its appendages; second, in the mental field, the development of associative memory. I say theoretically two epochs, because no dramatic beginnings of either the brain cortex on the one hand or associative memory on the other can be distinguished. But each appears in a gradual evolution. First in the selachians, the lizards, serpents, and the like, appear the beginnings of the new brain; and since that time in the animal series gradual development of the neencephalon has proceeded until we have the marvelous complexity of millions of interrelated neurones in the human brain cortex. The function of the central nervous system, we may say roughly, is to make protoplasmic connection between the receptor and the effector organs and to convert stimuli into reactions.

The significance of the new brain lies in the fact that its function is that of association; and the animal with this new brain has the ability to profit by its own experience, and what we speak of as the marvelous learning ability of the human being. For our present purpose, it is merely necessary to recall these fundamental facts, especially this ability to form associations.

**Association and the Studies of Pavlov**

The laws of the association of ideas have long been known; but only recently was it discovered that when stimuli of disparate character—for example, sensations of taste and sound—occur simultaneously, they, too, become associated and the laws of this association are in large part similar to the laws of association of ideas. This was a great discovery. The method based on this fact promises scientific results in many baffling problems.

The discovery of the association of stimuli was made by Russian investigators, the chief of whom is Pavlov (32, 33, 34). This great physiologist has studied the secretion of the salivary gland in the dog as affected by different stimuli, and developed a most elaborate technique for this purpose; but the results may be described in very simple language. We may take the classic example, a story often told, but still as wonderful as ever.

If you give your dog a piece of meat, a secretion of saliva occurs. The stimulus of the taste or odor of the meat is followed by the secretion of saliva as a response. This is an ordinary spinal-cord reflex. If, every time you give your dog a piece of meat, you ring a bell, after a while you can ring the bell without giving the meat and nevertheless there will be a flow of saliva. The sound of the bell has become associated with the stimulus of the meat and produces the same physiological reaction of the gland. Such an associated stimulus is called a conditioned, or associated, stimulus, and the reaction produced a conditioned reflex. In this case, according to Pavlov, the association is functioned by the brain cortex.

According to Pavlov, to note first his general view, the function of the higher brain centers is governed by the fundamental principle of the flow of nervous energy toward the point of greatest irritability; and as a matter of fact, this point shifts from one part of the cortex to another, and consciousness is, we may assume, the correlative of this shifting affectability. Pavlov, to be sure, puts this as a monist and makes consciousness itself a physiological phenomenon; but the general theory holds as well, and is quite as scientific, if we study this shifting focus of irritability as the mere correlative of consciousness, leaving the question of the relation between consciousness and the neural processes as a metaphysical problem with which we are not concerned. Thus Pavlov's picturesque metaphor may be adopted as translated by Morgulis (30):

"If it were possible to look through the skull, and if the region of optimum affectability in the hemispheres were lighted up, we might see in the thinking, conscious human being a bright spot of fantastically ragged outline, of perpetually changing form and size, migrating over the hemispheres, surrounded by more or less complete darkness hanging over the rest of the hemispheres."

In other words, this focus of irritability in the cortex, constantly shifting from one part to another, we may naturally suppose is correlated with one's consciousness or one's special
activity; and the other and relatively inactive parts are the correlative of what is commonly called the unconscious and our possible activity. That is, they are potentially related to consciousness; and when the focus of optimum irritability shifts to them, they in turn become correlated with conscious activity. Besides all this, however, we must suppose there is a process of shifting irritability and the fusion of stimuli not correlated with consciousness, but nevertheless forming the association of stimuli in conditioned reflexes.

We may, then, to put the whole matter with arbitrary simplicity, say that the brain cortex seems to be the seat of a constant ebb and flow of excitability. To use the word focus or center loosely, as Pavlov and Krasnogorski (24) do, we may say that certain centers are continuously the seat of greater or less irritability, and whenever stimuli from the different receptor organs come in to the cortex, they tend to associate themselves with those centers which are especially stimulated at the time. Or, in other words, the path of least resistance is the path which is already the seat of excitation or in the direction of such an excited center. Hence the great fact of association—that any stimulus, however indifferent, tends to become associated with other stimuli which at the given moment are active in the brain cortex.

A simple illustration used by Hough may make this condition clearer. We may liken the paths of increased irritability between nerve centers that are excited, or between new stimuli that come into the brain cortex and the centers that are in a condition of highest irritability, to the areas of increased intensity of illumination in different parts of a room lighted by electric lights. In the paths between the different lights there is a greater intensity of illumination than in other parts of the room. If we imagine a room lighted by such electric lights which are constantly shifting their position, we have the analogue of the shifting irritability in the brain cortex between different centers that are in a condition of excitation, and between stimuli that occur simultaneously.

Physiologically, the great significance of the conditioned reflex is that it furnishes an objective method of studying the function of the cortex; psychologically, it is of importance as a method of studying association.

Pavlov's students have produced a large amount of data, the investigations having been made with dogs, monkeys, and children. A vast number of illustrations could be cited. If you sound a definite tone every time you give the dog meat, then that tone becomes associated with the original stimulus and produces the flow of saliva without the meat. Whistling is capable of association to produce the same conditioned reflex. Scratch the dog in a definite place every time he is fed, and a conditioned reflex is formed for the scratching. Even pain on a definite spot of the skin may become associated to produce a similar conditioned reflex. If we may trust these investigators, even place a piece of ice on the skin every time the dog is fed and, after a number of repetitions, you may merely place the ice on the skin and the flow of saliva will occur.

Now when a piece of meat is the stimulus that makes the dog's mouth water, it does not especially excite our wonder because we are familiar with such simple reactions; but when an entirely indifferent stimulus—a musical note, or the ringing of a bell, a piece of ice on the skin, or even a painful sensation, an electric shock, or the like—becomes associated with the meat and produces the same reaction of the gland, it certainly is remarkable; and possibly for every gland in the body and for every motor organ, similarly associated stimuli can produce specific reactions.

Of course the stimuli that occur naturally in an animal's environment have the same effect as those artificially supplied in the laboratory. This is why, in experiments on the conditioned reflex, it is necessary to take such great precautions—to use a special room, sound proof, the experimenter himself, in some cases, being in another room and operating the apparatus without being seen by the subject of the experiment, in this way isolating the special stimuli one is studying.

It has been found by Pavlov and his students that, either under the controlled conditions of the laboratory or under the ordinary conditions of natural environment, any stimulus whatever, from any receptor organ, however indifferent the sensation, may become associated with the biologically adequate stimulus and produce the same effect—that is, produce a conditioned reflex.
The significance of all this is that Krasnogorski (23) in Russia, Dr. Mateer (27) at Clark University, and Dr. Watson (37) of Johns Hopkins, have found that in children as well as in animals similar conditioned reflexes can be formed, conditioned reflexes for the salivary gland, conditioned reflexes also for motor organs, conditioned reflexes, perhaps, for every gland and motor organ in the body.

INHIBITION

Pavlov's experiments have thus made clear what the conditioned reflex is—namely, a reflex produced by any indifferent stimulus associated with a biologically adequate stimulus. In other words, if an indifferent stimulus is repeated a certain number of times simultaneously with the biologically adequate stimulus, an association is formed so that it comes to pass that the associated indifferent stimulus produces precisely the same physiological effect. If we could leave the whole matter here, it would be relatively simple; but the processes in nature are seldom simple; and in this particular case, we have yet to consider the other side of the whole matter—namely, the function of inhibition.

If one scratches a dog every time he is fed, then the scratching becomes a conditioned stimulus; that is, it occasions a secretion of saliva when no food is given. Now when a conditioned reflex of this kind has been formed, if, during the scratching, a new stimulus—say, for example, a tone that has been made a special stimulus—is added, immediately the scratching stimulus loses its effect. Also, the adding of another unusual tone to a usual one inhibits the salivary reflex, the stronger the tone, the greater the inhibition. Pavlov and his students have made extended investigations of the different forms of inhibition, and they find that such a simple reflex as the secretion of saliva is influenced by innumerable factors, not only by the more intense stimuli, but by any stimulus from the environment, by any sound, however weak, the flickering of a light, a shadow on a window, or even a draft of air or the like.

Since the term inhibition has often been used vaguely and loosely, it is well here again to approach the subject from the objective point of view. Following Sherrington (35), we may sum up briefly the significant points. The first is the fact of the existence of inhibitory nerves and the inhibitory effect on the muscles of inhibitory summons from the nerve centers.

In 1846 Weber discovered the inhibitory action of the vagus nerve on the heart muscle. Later Pflüger discovered the inhibitory nerve that passes to the muscle of the wall of the intestine. Later other inhibitory nerves were discovered in invertebrates, but no such nerves to skeletal muscles in man could be discovered. These inhibitory nerves were efferent nerves from the nerve centers; but, as Sherrington has pointed out, it is not necessary to have such nerves directly to the muscle in the case of skeletal muscles in vertebrates. The muscle contracts only on behest of the motor nerve center.

This trustworthy scientist has shown that inhibition is a positive function, and he draws a significant parallel between stimulation on the one hand and inhibition on the other, in part as follows: Although the processes of excitation and of inhibition are polar opposites, and although one is able to neutralize the other, there are correspondences between reflex inhibition and reflex excitation. Both undergo fatigue. Both outlive their stimulation periods for a short time in proportion to their intensity. The latent period of both is about the same. Many of the time relations of the one resemble those of the other.

That the stimuli of the environment have power to excite this or that form of activity has long been known. That, on the other hand, these stimuli have power to arrest or inhibit such activity has been worked out only recently. The intimate nature of the reflex inhibitory process remains obscure; but, as Sherrington has described it, started by nervous excitation, reflex inhibition seems, detail by detail, to present an exact counterpart to nervous excitation. "Often the two processes meet and neutralize each other according to dosage, in appearance as do acidity and alkalinity."

"In all these uses of inhibition we see it as an associate of, and a counterpart or counterpoise to, excitation. Whether we study it in the more primitive nervous reactions which simply interconnect antagonistic muscles, or in the latest ac-
quired reactions of the highly integrated organism, inhibition does not stand alone, but runs always alongside of excitation. In the simple correlation uniting antagonistic muscle-pairs, inhibition of antagonist accompanies excitation of protagonist. In higher integrations, where, for instance, a visual signal comes by training to be associated to salivary flow, the key of the acquiring of the reflex and of its maintenance is attention. And that part of attention which psychologists term negative, the counterpart and constant accompaniment to positive attention, seems as surely a sign of nervous inhibition as is the relaxation of an antagonist muscle, the concomitant of the contraction of the protagonist. In the latter case the coordination concerns but a small part of the mechanism of the individual and is spinal and unconscious. In the former case it deals with practically the whole organism, is cortical and conscious. In all cases inhibition is an integrative element in the consolidation of the animal mechanism to a unity. It and excitation together compose a chord in the harmony of the healthy working of the organism."

(35, p. 309.)

In the field of the conditioned reflexes several forms of inhibition appear. Associated stimuli, on account of their unstable character, are especially liable to inhibition. Any new stimulus is likely to inhibit whatever conditioned stimulus is active; and then again any new stimulus is likely to inhibit the inhibition. Thus the whole matter of association, both in our coordinated activity and in our thinking, is extremely complex. Just as, in the case of the muscles, constant interplay of stimuli and of inhibitions occurs, so in the mental field we must conceive an equally complex interplay of associations and inhibitions, and a continuous action and reaction of stimulation and inhibition, in the conditioned reflexes and systems of conditioned reflexes that are active in any individual who has had experience—in the child after the first year and a half or two years, perhaps, of life, and in much more complex fashion in later years.

The inhibitory effect of the environmental stimuli referred to above is gradually to wear out the conditioned stimuli and the conditioned reflexes. Hence, as all the investigations show, the conditioned stimulus needs to be continually re-

enforced by association with the unconditioned or original stimulus; and when such repetition does not occur, the conditioned reflex soon disappears. This dying out of the conditioned reflex is thus to be looked upon as a form of inhibition, and concrete illustrations are plentiful.

Thus, while the first form of inhibition is the definite and sudden extinction of a conditioned reflex by inhibition of the associative stimulus by some new stimulus of sufficient intensity, the second form of inhibition is the gradual wearing out of the conditioned reflex by the inhibitory effect of the ordinary stimuli of the environment.

It should be noted that this condition of inhibition in turn is very unstable and easily removed by the occurrence of other stimuli. If, when a conditioned reflex has died out for lack of reinforcement of the associated stimulus with the original stimulus, some new stimulus suddenly occurs—for example, the light of an electric light thrown into the dog's eyes, a stimulus that has no relation to the original stimulus—it acts at once as an inhibitory stimulus; that is, the sudden flash of the electric light removes the inhibiting stimulus and reestablishes the conditioned reflex. One or two illustrations given by Anrep (1) may be cited:

"After repeated experiments with Dog 4, when the differentiation of the second sound had been firmly established [so that no secretion was expected], something irritated the mucous membrane of the animal's nose and the dog sneezed. Three minutes later an inactive note was sounded, and, instead of the zero anticipated, 28 drops of saliva were registered. No secretion was caused by the sneezing, but the irritation produced inhibited the inhibition."

"In another case, when experimenting with Dog 4, a large fly flew into the room; this very slight noise was quite sufficient to inhibit the inhibition and to cause the secretion of 15 drops. If a metronome or a simple bell is set in action during the sound of the inactive tone, one gets a still greater effect."

Thus the Russian investigators have shown the significance of inhibition for the nerves as Sherrington has for the muscles—i.e., that in all development and training of the central nervous system, inhibition is as important as response. Accord-
to Krasnogorski, stimulation and inhibition are in a certain sense the two halves of one and the same activity of the nervous system. And he maintains that in the conditioned reflex we have an almost ideal method of investigating the process of central inhibition in children.

We may simplify the complexity of the whole matter by a general statement such as that given by Anrep (1):

"Each extra stimulus in turn inhibits the conditioned activity of the brain, superimposing itself on the process it encounters in every part of the same. If it meets with excitation, it inhibits the excitatory process; if it meets with inhibition, it inhibits the inhibition."

I have referred to the discovery by Pavlov as remarkable, but, like many other great discoveries, it was in one sense very simple. For thousands of years nature has been forming conditioned reflexes and inhibitions. Any observer of children and animals can give examples.

In case of one of our Worcester dogs who is fond of visitors, the ringing of the doorbell has become associated with the coming of callers, so that whenever the dog hears the bell ring, he comes tearing into the house. The housemaid has discovered that when it is necessary to lock the dog up, the ringing of the bell is a convenient method for bringing him into the house. The presence of callers was the original stimulus, coming into the house the response. The ringing of the doorbell is the associated stimulus. It produces the same response—coming into the house—as a conditioned reflex.

A conditioned reflex is often established by shock or by a single intense association between the original stimulus and the associated stimulus. This can frequently be observed in the ordinary behavior of animals. Watson cites the well known case of the horse frightened in a definite spot and afterwards always showing fear when passing that particular place.

From the training of animals we have noteworthy examples also of the power of inhibitory stimuli. Kallisher has given so-called tone training to different animals. With monkeys, by giving them food with a certain definite tone and withholding it with other tones, he habituated them to grasping the food only at the proper tone, the one associated with the giving and eating of the food. In another case, a Boston terrier was taught to sit in his chair with meat placed before him until permission was given to take the food. Even when the dog's favorite food was placed directly under his nose and he was left in the room alone, he would not touch the food until his master returned and permission was given. In their natural environment also scores of inhibitions in animals are developed.

A great part of the training of animals consists in the development of conditioned reflexes, especially, perhaps, in the acquisition of the more unusual tricks. A friend of mine trained his dog to sneeze at the word of command, first rubbing his nose and causing the unconditioned reflex of sneezing in response to this irritation, then repeating the word of command with the rubbing until finally the dog would sneeze at command without the mechanical irritation. If in this case the sneeze was a true reflex, then we have a conditioned reflex, the word of command being of course the associated stimulus. More commonly the training consists largely in the development of inhibitions. The reader can add illustrations from personal observation.

We are specially concerned with the development of conditioned reflexes in children. The significance of inhibition in children will be considered later in connection with the school. Here it may be added that several kinds of inhibition are distinguished. Morgulis (30, p. 372) enumerates some of these as follows:

"There are several kinds of internal inhibition. Waning conditioned reflexes, due to a repeated application of the conditioned salivary stimulus without the aid of an unconditioned stimulus, is one kind. Another kind is the delayed reflex which appears if the conditioned stimuli are regularly followed by feeding a few seconds or even minutes after the conditioned stimulation has ceased. Conditioned inhibition is likewise a form of internal inhibition arising when an irrelevant factor is added to the conditioned stimulus, the combination not being reinforced by feeding. In such a combination the conditioned stimulus is quite ineffective, but alone it exerts the usual influence. The process of differentiation and
concentration, already described above, represents a still other type of internal inhibition—the inhibition of differentia
tion. Furthermore, it is a very common and very import-
tant occurrence that an inhibition checks another inhibition,
the result being a reactivation of the inhibited reflex.''

LEARNING, FATIGUE, GROWTH

From the results already obtained, it is apparent that per-
haps the most deep-seated significance of stimulation and in-
hibition in the production of conditioned reflexes lies in their relation to learning, fatigue, and mental growth. Learning
in the broad sense—i.e., adjustment to a new situation—
means the association of stimuli and inhibitions in the pro-
duction of a system of conditioned reflexes. It means the in-
hibition or breaking down of reflexes that do not prove useful.
It means remembering and forgetting as well.

What is called brain fatigue, even though its chemical cause
be the toxic products produced by functioning neurones, is
perhaps usually due, as Krasnogorski thinks, to some general
inhibition—i.e., an inhibition so strong that it spreads over
the whole cortex. To remove the fatigue, all that is necessary
is a stimulus sufficiently strong to remove the cortical inhibi-
tion. The physical mechanism by which the removal of the
inhibition is effected may be complex, involving the autonomic
nervous system, the secretion of endocrine glands, and the like,
but from our present point of view the essential factor
in the process is the associated stimulus that inhibits the
inhibition.

Again, what is sometimes called the plasticity of the ner-
vous tissue—the ability to form, to retain, and to break
down temporary associations—conditions mental development.
Without this plasticity, we have that arrest of development
we call feeblemindedness if it occurs before the age of fifteen
or sixteen, dementia praecox, senescence, or the like, if it
occurs after that age.

The different stages of decline in mental age, the arrests
that occur in senescence, have not been systematically studied.
But when an individual can no longer form and break down
conditioned reflexes and habits (systems of conditioned re-
flexes), he is senescent, whether his chronological age be
twenty-five or seventy-five. And one who can still form the
temporary associations and adjust to the new situation is
still young though his chronological age be ninety. The men-
tal age, not the chronological age, is significant in senescence
as well as in adolescence. The great aim of mental hygiene
is to preserve this plasticity of the nervous substance.

The problem how this plasticity may be retained I am not
able to solve. Its discussion would involve the study of other
factors, such as the mental attitude and especially the proper
functioning of the endocrine glands and the autonomic ner-
vous system. The significance of the mental attitude to men-
tal health is suggested by everyday observation as well as
by laboratory studies of the higher mental processes. The
normal functioning of the autonomic nervous system has been
shown to be vital and fundamental to healthful mental de-
velopment. But all this is another story that cannot be told
here. The writer's task is the far simpler one of suggesting
some of the practical applications of a knowledge of the con-
ditioned reflex in education and mental hygiene.

THE CONDITIONED REFLEX IN THE CHILD

The power to form conditioned reflexes occurs at a very early age in the child. According to Krasnogorski (23, 24),
this power of association appears in the first year of life, and
observation and the studies by Dr. Mateer (27) indicate that
it appears at a still earlier age. Probably in regard to a few
things it appears in infancy; and yet, as Krasnogorski main-
tains, it is not developed until during the second year, per-
haps not until the child is about two years of age.

The mechanism of conditioned inhibition also, according
to Krasnogorski, occurs at the end of the first year of life,
and this, according to him, marks the stage when the child
can be really educated. Naturally there are individual dif-
ferences in the time of development, and in the case of feeble-
minded children the conditioned inhibition can be formed
only with great difficulty or not at all, and such associations
have weak inhibitory effect and are easily destroyed. In
normal children, however, in the first year or two of life, a
vast number of conditioned reflexes and conditioned inhibitions are formed by the ordinary environment and by the training given by parents and nurse.

Obviously in the case of children the different learning types appear in the development of conditioned reflexes and there are rather wide individual variations in the ability to form associations. The results given by Dr. Mateer (27) are perhaps representative:

"It may be interesting to note that no child over two years of age needed more than eight trials, while none under that age used less than seven, none under three years needed less than six, while the minimum number, three, was all that were required by a child in the fourth year. Out of the fifty children, regardless of age, ten needed only three trials, eleven needed four trials, eleven used five trials, while only seven needed six; five needed seven, four needed eight, and two, nine trials."

The mechanism of the conditioned reflexes in the child varies from that of the animal in several respects. The first characteristic in the child is the extreme rapidity of its acquisition. In the case of the normal child, it is enough to let the effect of any stimulus occur in connection with the opening of the mouth from two to ten times for the temporary association to be formed and for the associated stimulus to call forth independently the opening of the mouth. Further characteristics of the conditioned reflex in the child are the high stability of the association formed and the ease with which it is broken down. The newly formed conditioned reflex in case of a normal child lasts for a long time, but at any time it can be quickly broken up and again reestablished.

For the extremely interesting results of Krasnogorski's experiments on memory reflexes, and the mechanism of storage and discharge in children, and the technical methods used by Dr. Mateer, Watson, and Lashley in this country, reference must be made to the literature (26, 7). We are concerned merely with the simplest outline of the results of the study of the conditioned reflex and some of the wider relations and applications suggested.

In the case of a child, all the conditioned reflexes of the various kinds produced in animals may be produced and many others besides, apparently. The whole of the child's education from the early years is largely the development of conditioned reflexes from the stimuli of the environment. These are the reflexes especially significant for health.

The infant is conditioned to react to certain specific stimuli, certain sounds of the voice of the mother or the nurse indicating the time for nursing, the sight of certain places indicating the time for a nap, the sight of the bathroom and toilet indicating the time for the bath or the like, and later the sight of cup or spoon or the like indicating the opportunity for food or drink; and again the child is conditioned to certain forms of behavior by the petting or indications of favor and esteem of mother or nurse or playmates, and so on in a hundred ways. Still later, by the training of social groups, the child is conditioned to all the rules of the game—habits of politeness, the conventions of society, etc. Naturally the earliest and most important group of conditioned reflexes is developed in connection with the person and behavior of mother or nurse. As Kempf (22, p. 76) has expressed it:

"The mother's voice, facial expression, color of hair, odors, eyes, skin, the shape of her mouth and conformations of teeth, her neck, bosom, arms and hands, touch and step, postural tensions, irritability and goodness, habits, ideals, and eccentricities, are all stimuli that come to have a potent autonomic-affective influence upon the child through being frequently, simultaneously associated with the giving of nourishment, physical comfort, and relief from fatigue, loneliness, and anxiety. This continues as an almost incessant combination of stimuli, varying somewhat as the mother's affections (love, anger, sorrow, shame, pride, jealousy) determine her reactions to the infant."

Thus conditioned reflexes are formed in children at a very early age, and by the time they come to school they are bundles of such reflexes. These reflexes are formed in the most commonplace and unsuspected situations, in an ordinary environment as well as in the laboratory. Usually the association is produced by many repetitions. It may be produced by shock. A simple concrete case will serve as illustration.

While a young child was lying in bed, a curtain at one of the windows snapped up suddenly with a loud noise, and the
child began to cry. The child was quieted, but the next time he was put in this room, he at once looked up at the window where the curtain was and again began to cry. The father was a physician and removed the child from the room. Had he not done so, a permanent conditioned reflex would very likely have been developed, so that the sight of the curtain would every time have made the child cry as a result of the conditioned reflex set up by the original shock, and his parents would have wondered why in the world the child was afraid of a curtain.

Simple incidents like this are especially instructive because they show that a conditioned reflex may be developed by a single experience, that what is a shock to the child may be the most commonplace and familiar experience to an adult. In this case the cause of the crying was obvious. In a hundred cases it may be unknown. Many of the cases of fear due to shock in early life are probably cases of this kind, and of course special care should be taken to avoid the formation of such reflexes.

THE SCHOOL

The school, of course, especially those schools in which the emphasis is placed on training rather than instruction, makes a systematic attempt to develop conditioned reflexes helpful for the tasks of life. The child, however, when he comes to school, is, as already suggested, a bundle of conditioned reflexes, some healthful and some unfortunate if not pathological, due to training in the home. Watson considers this training so vitally significant that he says: "I believe I could make or break a youngster in the first four years of its life; that is, without abusing it, starving it, or otherwise being cruel to it, I could twist, thwart, over- or under-develop its instinctive and emotional life to such a degree that it would never recover from it."

According to Watson's view, most of a child's behavior is acquired by training in the early years, and the instinctive and emotional mechanism is relatively simple. This of course means that the child's behavior is largely determined by conditioned reflexes. If this be true, then the tendency of stimuli to inhibit such reflexes and the various forms of inhibition of conditioned stimuli and conditioned reflexes, which Pavlov's studies have shown in such abundance, must be a significant factor in the child's life. Even by the time the child enters school, he is, from a physiological point of view, far from being unsophisticated; and, as regards health, even at this early age he may be handicapped by a large number of unfortunate inhibitions.

Formal education is largely made up of inhibitions. Necessarily this is so. The child's social education is chiefly a matter of acquiring inhibitions. The first thing in the social education of a child is to teach him to talk. The second is to teach him not to talk. The first scholastic education is to teach a child to read and to read every word and every sentence of his lesson; the later training of the scholar consists largely in teaching one what he should not read, and training one to ignore the unessential. To inhibit or delay reaction is the mark of the educated man.

Thus it comes to pass that sometimes repression goes too far, and an abnormal and exaggerated habit of repression is developed. This may be distinctly injurious to a person's character, and probably in not a few cases the most serious handicap to one's efficiency is such a habit of repression or inhibition.

Such inhibitions usually being unconscious, the individual himself may not know what it is that handicaps him; and yet in thousands of cases the boy and girl as they come out of school are less efficient and less able to do things in a clear-cut and thoroughgoing fashion than when they enter school as children.

If Watson's conception be correct, then the importance of a thoroughgoing mental examination at school entrance is emphasized. With twenty or forty children, each a bundle of more or less active conditioned reflexes developed in homes of diverse character where children are subjected to many different stimuli, how can a teacher be supposed to act intelligently in discipline and instruction without knowing all that can be learned by expert examination in regard to the results of home training? Plenty of time should be taken for such an examination, and especially important in throwing light on the questions involved would be the study of the spontaneous behavior of the children by a competent expert.
Such thoroughgoing examination of individual children will show that inhibitory conditioned reflexes exist likely to handicap the child not only in school work, but in the development of habits of mental health. We usually call these attitudes, habits, fears, peculiarities, and the like.

With the innumerable repressions and exhortations from childhood—not to do this and not to do that, and to avoid certain forms of speech and certain forms of behavior—it is no wonder that by the time manhood is reached, or perhaps long before, a great accumulation of such inhibitory associations has been acquired; and this more than anything else is the handicap of many individuals. Years ago Dr. James, in his classic paper on the hidden energies of men, gave many examples of men whose efficiency had been greatly increased by some striking emotional experience—a conversion, a love affair, a great shock, or the devotion to a new cult or what not, something that raised the individual to a higher level of activity, and greatly increased his efficiency, so that thereafter he was able to live on a higher plane as a result of the hidden sources of energy that were tapped by the emotional experience, as James expressed it. Probably in many of these cases the real psychology of the individual's improvement was to be found in a removal of inhibiting associations, a release from this result of repressive education, the inhibiting accumulation of a lifetime.

Many most brilliant men and women have their activity limited and their efficiency seriously retarded by such conditioned reflexes, and the remarkable results that occur when by proper training or by shock these conditioned reflexes are broken up and these inhibitions removed have been demonstrated in many cases.

Of more serious inhibitions we have plenty that are more or less pathological. In the experiences of "shell shock" throughout the war, we have innumerable illustrations of such inhibitions. The frequent cure of "shell shock" by a shock of some kind illustrates the way in which such inhibitions can in turn be inhibited by other stimuli if they are sufficiently strong, while the cure of such cases by training, on the other hand, shows how, by many repetitions, inhibiting stimuli and associations may be developed.

The psychiatrists have long recognized that in many cases of nervous and mental disorder the most serious trouble is an inhibition of some kind. Just as one's intellectual ability is often arrested by unfortunate inhibitions—and these may be so deep-seated as to condition the difference between the ordinary man and the man of genius, as Bateson has suggested—so certain inhibitions may be so serious that their presence or absence means the difference between normality and serious mental disorder. Hence, as psychiatrists recognize, the important thing is some means of removing injurious inhibitions.

From the point of view of association and the conditioned reflex, the remedy for unfortunate inhibitions—whether conditioned reflexes, associated ideas, mental attitudes, fear, or what not—may be stated in general terms by saying that it is always possible to remove the inhibition by associating a new stimulus of sufficient intensity with the unfortunate association—that is, to inhibit the inhibition by a new and stronger stimulus. The new reflex or association may be established by shock, or by many repetitions, or by constructive activities in relation to the object of fear or the like—that is, by establishing a system of conditioned reflexes or associations.

This whole matter of inhibition and the widely related aspects of it should, in the light of the results that have been obtained, be studied as broadly and considered as generally as the law of stimulation and what we are apt to look upon as positive association.

PSYCHOANALYSIS AND THE CONDITIONED REFLEX

For psychoanalysis in the technical sense as employed by the psychiatrist in his clinic, or in the lay sense as practiced by a preacher in confession and the like, or by the teacher like Socrates, or by the individual thinker like St. Augustine, or Jonathan Edwards, in meditation, or by the individual patient, as advised to-day by some psychiatrists—for all these, the method of the conditioned reflex has an important contribution. The significance of this has already been suggested.

It is well illustrated in our social relations, or the affective situations of the individual in relation to other individuals and to the social group, especially when we consider the asso-
ciation of ideas and mental attitudes as well as the association of stimuli. Dr. Kempf does not put it too strongly in the following passages:

"The conditioning capacity of the reflex is of the utmost importance in determining our selections and aversions throughout life, such as mating, habitat, friends, enemies, vocations, professions, religious and political preferences, etc. We can understand now how we come to have an avertive prejudice for one person, experience, or object because it has qualities that happen to be similar to some of the qualities that another person, object, or experience had that caused us to feel pain, fear, or embarrassment. Similarly we prefer those new things that have some of the qualities of old things that were pleasing and invigorating stimuli."

"It seems naive to urge that every person, friend or enemy, is essentially a compound stimulus that varies more or less in its gratifying or distressing influence upon an individual, but the stupid resistance to psychoanalysis and the adjustments of repressions makes it necessary. The conditioning of fear, hate, love, shame, sorrow, hunger, occurs without our conscious choice that these affective-autonomic functions should or should not prefer to have or to avoid certain objects, persons, or situations. These mechanisms may often be obscure, but in one respect they are consistent. They are always determined by experiences."

Every one, perhaps, at some time has noticed the peculiar character of his own action or the strange things he finds himself sometimes saying. Many of us have comforted ourselves by the clever explanation given by Oliver Wendell Holmes, who states that such things are to be explained only on the supposition that we have a mental blind spot which sometimes functions so that idiotic ideas of any kind whatever may become associated. Probably many of these cases are to be explained as obvious conditioned reflexes.

We can sometimes detect these mechanisms in concrete and trivial matters, as well as in those more serious referred to by Kempf, but the ordinary person is not likely to notice them.

1 See The Tonus of Autonomic Segments as Causes of Abnormal Behavior, by Edward J. Kempf. Journal of Nervous and Mental Disease, Jan., 1920, p. 16.

A classical case was given by Betz from his own experience, reported in substance as follows: Riding in a street car one day, Betz saw a man settle himself comfortably with a cigar in his mouth. Just then a slight accident jolted the car and threw the cigar out of the man's mouth in a ludicrous fashion which caused Betz to smile. Some days afterwards, he met a stranger on the street and found himself involuntarily smiling. Then he tried to recall the man, whose face had a familiar look, and the involuntary smile enabled him to do so. The man was the victim of the street-car incident that had caused his amusement.

Here the smile was an ordinary example of a conditioned reflex. The personal appearance of the man seems to have had no essential relation to the humor of the situation; it would have been as ludicrous in the case of any other man. But the appearance of this man became associated with the original situation as a conditioned stimulus and brought the same smile.

Instances of this kind, in which a part of a situation conditions the reaction to the whole of it and also brings about a recall of the original circumstances, are of everyday occurrence. The unfortunate social possibilities in a case of this kind are obvious. Hundreds of people, especially school children, have gotten into trouble by smiling at the wrong time; and the schoolboy is likely to be entirely innocent and quite unaware of the reason for his smiling. Innumerable occurrences in the schoolroom, misinterpreted both by teachers and by amateur Freidians, are probably cases of this kind. The point of view of the conditioned reflex gives a simple explanation of much bizarre behavior and ridiculous speech.

Without attempting any critique here of modern methods of psychoanalysis, one point is so clear that all competent specialists will perhaps agree in regard to it—namely, this hygienic necessity of removing unfortunate inhibitions; and, so far as clearing the field and removing obstacles to healthful mental development goes, it is perhaps not too much to say that the aid given the patient by psychoanalysis in the removal of such inhibitions is the most important benefit rendered.
Without technical language or details, the essential psychology of the mode of procedure may be simply and briefly illustrated in the case of the universal inhibitions of fear.

Probably everybody, especially every child, is handicapped by inhibitory fears of some kind. Such inhibitions may be illustrated by almost any of the common, but often grotesque, fears of childhood. For example, a little girl had heard certain incendiaries referred to as firebugs and had listened to a newspaper account of a terrible fire which, according to the report, was set by a firebug. She thus gained the idea that there were certain insects that set fire to houses, and naturally enough she became afraid of these incendiary bugs, lest her own house might be set on fire. To a child's imagination, an insect like this that walketh in darkness and can effect such tragic results naturally became a secondary cause of fear. Usually a child conceals such fears. If discovered, the method of removing them is simple. But concealed and repressed, a fear of that kind or the inhibition it leaves is liable to cause injury for a lifetime, as every psychiatrist knows. Dr. Rows, of London, told at Bloomingdale of a case of nervous breakdown and insanity in a woman of thirty-five which was traced back to a fright the child received at the age of five from the bogey stories and behavior of her nurse.

Let us take another concrete case: Charles Lamb, in his well-known essay on Witches and other Night Fears, says of himself: "I was dreadfully alive to nervous terrors. The nighttime and solitude and the dark were my hell... I never laid my head on my pillow, I suppose, from the fourth to the seventh year of my life, so far as my memory serves in things so long ago, without an assurance, which realized its own prophecy, of seeing some frightful specter." The form of his visitations he attributes to the picture, in Stackhouse's History of the Bible, of the raising of Samuel by the Witch of Endor.

Whether the morbid attitude be of long standing or recent, the psychology of the remedy is briefly as follows: One brings the fearful idea clearly to consciousness—lowers the threshold for the idea, as the psychologist puts it. In other words, one brings the child definitely to face the cause of its fear, just as the horse trainer, with soothing words, leads the colt up face to face with what has frightened it. Then one associates a rival stimulus with the fear-inspiring object or idea. In the case mentioned, one would show the child, perhaps, the grotesque and comic aspects of the Stackhouse picture, or convince him that it was nothing but a drawing on a piece of paper similar to what he himself could make—that it represented at most an imaginary object, a make-believe representation. By such a discussion, rival stimuli would be associated with the picture, and after a few conversations of this kind, these associated ideas would inhibit the fear; amusement or orderly thinking would take the place of it. It is always possible to associate a wholesome thought or attitude with the original stimulus as a rival stimulus that shall in turn inhibit the inhibition.

The practical problem, then, is how to form some association with the general attitude of worry which so many people have, so that as soon as this attitude becomes nascent, it may at once be inhibited by some healthful association. That this can be done and actually is done in many cases we have evidence from many individuals of different classes in society, diverse interests, and varying degrees of education. Apparently it may be any one of a number of things, if only the association be made strong and permanent.

The mere knowledge of the fact that violent change of stimuli causes the fear, this itself may become an associated idea that tends to inhibit the fear. The individual says to the fear-producing situation, "I know the secret. 'I have your number.' With a little easily made apparatus I could do the trick myself." If in no other way, this reduces the fear by the fact that it represents so much coördinated thinking, which, like coördinated action of any kind, is a universal remedy.

Dr. Crile and Dr. Cannon have borne testimony to the fact that in their own cases, since learning the seriously injurious results that come from worry and anxiety, they are able to meet the trying situations of life with greater equanimity. As Crile has put it, the thought of the injury that comes from these emotions is itself a protection against them.
Pathological

On the basis of pathological heredity and often, apart from this, merely from unfortunate environment and bad training and the constant interference of over-anxious parents and nurses and others, unfortunate and pathological reflexes are sure to be produced. Thus the work of education in the schools as well as in the hospitals often becomes, to a large extent, the inhibiting and breaking down of injurious reflexes, or, to put it more concretely, the building up of healthful conditioned reflexes and habits or systems of such reflexes that may inhibit injurious ones. Multitudes of examples could be given if there were time. A few miscellaneous illustrations will suffice.

According to Ibrahim (16, p. 39) the phenomenon that a child shows when he holds his breath is a conditioned reflex of a typical kind. Because of a neurotic temperament or the like, in a fit of passion, perhaps, the child holds its breath once, and this is enough to cause a conditioned reflex. Thus, whenever the child thereafter falls into a fit of passion and crying, the crying becomes a conditioned stimulus for stopping the respiration, and always afterwards, every time the child cries in a fit of anger, he will hold his breath in the same way. This explains a large number of troublesome cases in the behavior of children.

It is an easy matter to allow such a violent reaction or inhibition of a normal function to occur, and the association is so intense from the circumstances of the situation that thereafter the child is conditioned, by the act of crying or the sound of his own voice or the like, to an inhibition of the function of respiration. It is interesting to note also that a usual method of cure is to throw water in the child’s face or in some way give a shock that will inhibit the inhibition.

In another case cited by Heilbronner (16), a child has to pass by a dog’s kennel, when suddenly the dog rushes out barking, without, however, being able to do any harm because it is chained. The child cries, tries to run away, falls, and remains crying and trembling, and is calmed again after a longer or a shorter period with or without any clear recollection of what has happened. The event for the time being remains without any result; but it is noticeable that the child attempts to go around this spot in which the experience occurred. It is thought unpedagogical to permit this timidity; the child is forced to walk again by the kennel; but before it comes into the vicinity of the dog, the attack of fear recurs. Further attempts at education in this direction are given up, but at every opportunity brothers and sisters or playmates tease and laugh at the child for his timidity. The result is a new attack. This occurs more and more frequently and under continually varying conditions with each unpleasant impression—a difficult school task, the denial of a wish, in case of very slight physical indisposition, and finally even on occasion of pleasant events and a pleasant surprise or the expectation of such.

In this example we can trace the way the circle of effective stimuli keeps growing wider—from the repetition of the original situation to the mere mention of the same, and from this to unpleasant situations in general, and finally to events that have nothing more in common with the original conditioned stimulus. Training in action in relation to the cause of fear and the building up of inhibitory associations would have removed this fear. Rasmussen has reported a case that illustrates this.

“When R. was about three years old, she was frightened when an alarm clock, which she had never heard before, suddenly went off. She cried violently. But when a light was made, and she could see the alarm clock and was allowed to make it go off, her fright disappeared, and she quietly submitted to having the light extinguished. All she said was: ‘The little clock must not say that, because then R. will be sorry.’ In the time that followed, she was not frightened when the clock occasionally went off.”

Among a large class of people numerous conditioned reflexes for drugs, patent medicines, or even special kinds of food are often developed. The child cannot get along without his special food or medicine, the adult is the slave of certain definite drugs, and the like. Bad as the drug habit, in this sense, is, nevertheless drugs often seem to have an hygienic effect because they act as associated stimuli to healthful conditioned reflexes.

In many cases the cure seems to be the result, not so much
of the remedy given, as of the form in which it is applied. As Heilbronner points out, the psychiatrist may fail in his efforts until he decides to resort to some measure which, as the patient says, has always helped, a remedy recommended, perhaps, by some old shepherd, or an electrical treatment, or the like. As soon as the psychiatrist adopts this method—that is, applies the associated stimulus that has become effective in producing certain healthful conditioned reflexes—the cure is effected.

**Conclusion**

We have discussed merely one or two fundamental aspects of the conditioned reflex. A great many other things must be omitted. The remarkable possibilities of this method, and the opportunity it affords for studying some of the unusual, bizarre, and mysterious phenomena of human behavior, are obvious upon a little reflection. Whenever something unusual and even something apparently supernatural occurs in the reaction of the psychophysic organism, it is well to approach the matter from the point of view of the conditioned reflex before resorting to speculation or invoking the aid of spiritualism, Christian Science, or occult theories of any kind that cannot be verified. There is time for but a single illustration.

Many remarkable cases of so-called dermographism and stigmatization have been reported. The witches of the Middle Ages were reported sometimes to bear the word Satan inscribed in red on their backs, and saintly mystics to have carried the sign of the cross inscribed on their foreheads, or the like. Richet, the French neurologist, has reported a concrete and modern instance of a mother watching her child, who, in play, accidentally unfastened the catch of a heavy sliding door in front of the fireplace and was in danger of being guillotined. In the fright and shock of the moment, there formed on the mother's neck, the part threatened in her child, a red weal that endured for several hours.

The tendency of the human mind is to look upon such phenomena as supernatural. The explanation of some of these cases, however, is obviously suggested by recent investigations of the formation of conditioned reflexes in the vaso-motor field. These were carried out by Cytovitch (12) and others of the Russian school, apparently with great care to control conditions, and the results show that vaso-motor changes similar in character to those reported can be produced in the laboratory as conditioned reflexes.

Dr. Humphrey (19), in a noteworthy paper in the Journal of Abnormal Psychology, has attempted to show how largely the different Freudian mechanisms of transfer, symbolization, conflicts, and sublimation, may be explained from the point of view of the conditioned reflex without resorting to the usual theories of the unconscious. While Dr. Humphrey may have carried his explanation too far, on the other hand why need we resort to special mechanisms to explain those activities that are clearly explained simply by the ordinary principles of associated reaction in the production of conditioned reflexes?

One of the well recognized principles of science, so important in psychology and hygiene that it should be especially emphasized, is the rule accepted from the time of the Middle Ages that, in explaining phenomena, we should not multiply entities; and thus when a simple explanation by a well established scientific principle is supplied, the student should not confuse the issue by resorting to complex and speculative theories, however attractive these may be from their appeal to human emotion or from the high authorities that have advocated them.

The extent to which associated stimuli and conditioned reflexes occur in everyday phenomena is hardly realized even by those who have made special study of them. Nearly all the multitudinous inhibitions of daily life, slips in pronunciation, slips of speech, such as those recorded in the little German book, Versprechen und Versagen, all the forgotten memories—names of our friends, names of books, of places, of words that we wish to use and that constantly evade us—all the tantalizing memories that we know we possess, but that will not come when we need them, that are obviously in our minds potentially, but that we cannot recall merely because we always think of something else which inhibits the right memory—all these and many other similar phenomena, and all the various inhibitions of activity—from the stammering in our speech and the halting in our action to the more conscious inhibitions from hundreds of superstitions and the like
that paralyze straightforward activity—all such inhibitions, commonplace as they are, are examples of so many conditioned reflexes or associations. So that the aim of mental hygiene to develop fortunate associations and to break down the manifold inhibitions that retard our activity is one that concerns an enormous part of ordinary education and training.

Probably in every act of our daily lives conditioned reflexes are involved. Every habit is probably a system of conditioned reflexes. Watson distinguishes between the conditioned reflex and habit by saying that the conditioned reflex is the element and a habit is a series of conditioned reflexes. It is perhaps better to call a habit a system of conditioned reflexes, as Humphrey does. Every attitude and interest, too, probably involves conditioned reflexes. Thus learning consists in the formation of associations, conditioned reflexes, and systems of conditioned reflexes. Education is a systematic attempt to develop conditioned reflexes that signify normal adjustment to one's environment and efficient activity. In the regular performance of our daily tasks conditioned reflexes and habits should be formed that make for efficiency and also become an anchor to the mental health. The educational and hygienic significance of the conditioned reflex are equally great.

Think of the appalling complexity of the problem of the teacher who has to decide not only what stimuli should be associated with given situations to produce conditioned reflexes and what inhibitions should be developed, but also what inhibitions of unfortunate conditioned reflexes should be developed. The problem for the psychiatrist, in the matter of the reeducation of his patients, is often still more difficult, because of associations that must be inhibited or unlearned.

The contribution of the conditioned reflex to psychiatry is fivefold: first, in giving an objective method for study; second, in showing the elements of one's problems; third, in showing the way to develop healthful associations and to inhibit pathological ones; fourth, in saving one from many erroneous interpretations; fifth, in showing the significance of inhibition, and a method by which injurious inhibitions can be removed.

Summary

1. Apparently, in a child as well as in animals, any stimulus whatever may become associated with another stimulus that occurs simultaneously.

2. Apparently any stimulus whatever associated with sufficient intensity with the original stimulus will produce the same response.

3. An unconditioned reflex is an ordinary reflex. In general terms, it consists in the transformation of a stimulus into a response.

4. A conditioned reflex is one brought about by an indifferent stimulus associated with the biologically adequate stimulus.

5. Any sensory stimulus from any receptor organ may become associated with the biologically adequate stimulus and produce a conditioned reflex.

6. The physical basis for the association that produces conditioned reflexes is a process of neural excitation in the brain cortex. A stimulus coming in from the periphery tends to associate itself with any center that is in a condition of stimulation. The significance of the method is that it is an objective means of studying what occurs in the brain cortex.

7. The brain and mind are active, not passive, in the response to stimuli. Just as in ordinary sense perception a process of selection goes on, so in the formation of conditioned reflexes a selective and differentiating process is functioned by the brain cortex. This is what is called by Pavlov and his students analysis. It is in substance sensory discrimination.

8. This analyzing function of the child's cortex may be greatly reduced on account of various organic and functional disturbances of the cerebrum. So, for example, Krasnogorski observed in the case of idiots and imbecile children that neither mechanical nor thermal nor contact differentiations were possible. In various neuropathic conditions the function of the analyzer shows constant or intermittent disturbances. Differentiations appear difficult in the cases of these children, and have an unstable and indefinite character. In this respect the disturbances in differentiation of the taste and smell analyzers in case of rachitic children are noticeable.
9. Every excitation of a cortical structure brings about always the inhibition of others. The stronger the stimulation of one cortical system, the greater is the inhibition of others. The stronger the inhibition center, the more extended are the irradiations of inhibition. If, therefore, a strong active stimulation focus is present permanently in the cortex, the secondary reactive inhibition can always attain finally such a degree of intensity that its irradiation spreads to the whole cortex. In many nervous systems a moderate focus of stimulation conditions an extremely high degree of inhibition which irradiates extraordinarily quickly and broadly over the surrounding regions of the cortex. On account of this wide irradiation of the inhibition, and on account of the appearance of such intensive areas of arrest, naturally a more or less long-continued depression of the whole cortical activity ensues. This reduction of the cortical activity we are accustomed usually to discriminate as fatigue.

10. Thus cortical fatigue is not exhaustion, but only the reduction of the cortical activity in consequence of a transient, but widely distributed, irradiation of cortical inhibition. A more striking proof of this is the fact that such a general inhibition can be removed at any moment by any new external stimulation of sufficient strength.

11. Sleep is a general mode of arrest of the conditioned reflexes in contrast with other more specific modes of arrest.

12. Pavlov believes that by such investigations as those of sleep one may find the solution of the phenomena of hypnotism and the like. If ordinary sleep is a general arrest of the activity of the higher part of the brain, we can consider hypnotism as an incomplete arrest of various portions of the brain.

13. The law of stimulation and inhibition is briefly as follows: A new and different stimulus affects whatever process is active at the time. If this process is stimulation, it inhibits the excitation. If it is inhibition, the new stimulus inhibits the inhibition.

14. Conditioned reflexes, in contrast with the unconditioned reflexes, are unstable, temporary, always tending to die out if not reinforced by association with the unconditioned stimulus and subject to inhibition by any chance stimulus from the environment.

15. The child at birth is a paleencephalic organism; the connections between the old and the new brain have not yet been developed, and the individual is more helpless than a dog deprived of his cerebral hemispheres.

16. Very soon after birth, the process of connection of the old brain with the new begins, and the process of association making possible the formation of conditioned reflexes develops early, much earlier than most investigators, perhaps, have realized. The continued development of such reflexes marks the neural development of the child’s brain and mind.

17. From psychological investigation, it appears also that the child’s innate tendencies and native impulses are simple and his inherited tendencies generic and relatively few in number, so far as emotion is concerned, being, according to Watson, merely the fundamental emotional reactions of fear, anger, and love.

18. It has been suggested that to these innate impulses should be added the impulse to action which shows itself in the young child in the impulse to activity for its own sake, an impulse so generic that it constitutes the matrix from which many so-called instinctive activities are differentiated.

19. While, as already stated, we can distinguish in phylogeny no dramatic beginning of consciousness, we may note that in a general way the ability to form conditioned reflexes marks a tremendously significant epoch in animal evolution. It signifies the advent of the cerebral cortex. It makes education in the higher sense possible. It is fraught with the weightiest possibilities of advantage or of harm to the organism. It means the possibility of education.

20. The education of the child is largely a process of acquiring in the first place conditioned reflexes and then the more permanent associations and systems of conditioned reflexes that we call habits.

21. The great individual differences in children as regards learning are largely differences in the ability to form and to break down associations and conditioned reflexes.

22. One important aim of education should be to preserve
this plasticity of the individual which makes learning and development possible.

23. The conditioned reflexes in feebleminded and defective children are different in character; for example, the neural structure seems to be less plastic, and conditioned reflexes, once formed, are not easily broken down. A similar characteristic of the feebleminded child has been reported from observation. Such a child, once having learned a reaction or a habit, cannot easily change to a different one. This lack of ability to unlearn what has been acquired seems one of the distinctive characteristics of arrest of development.

24. In the acquisition of these conditioned reflexes during the early years of life, we have a record of the development of the special function of the neencephalon significant for psychology, pedagogy, and hygiene.

25. When a conditioned reflex has been established, the original stimulus itself is often reinforced by the associated stimulus.

26. The child is usually unconscious of the conditioned reflex—that is, the response occurs without his knowing why; likewise the child is usually unconscious of the reinforcement of the original stimuli by the associated stimuli.

27. Conditioned reflexes may be removed, as they are sometimes formed: (1) by shock, i.e., an intense stimulus that inhibits the conditioned stimulus; (2) by reconditioning, i.e., by establishing an antagonistic conditioned reflex by many repetitions.

28. As regards its wider relations, the method of the conditioned reflex offers a means of studying objectively the associative and inhibitory functions of the brain cortex and throws light on the association of ideas, mental attitudes, and the like.

29. The association of ideas, mental attitudes, and the like, are of two classes—either adjuvant or inhibitory to the tasks one has to perform. The importance for mental health of developing healthful associations and attitudes and removing injurious attitudes is as great as the development of healthful conditioned reflexes. Practically the same laws apply to both.

30. In accordance with the general principle of science that we should not multiply entities, but should choose simple methods of explanation of nervous and mental phenomena rather than complex hypotheses, it is well to study all the difficult and perplexing problems of mental hygiene first from the point of view of the conditioned reflex, resorting to other methods of approach later.

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