

GATES (E.)

Box 576

## PSYCHOLOGY, PSYCHURGY, AND THE KINDERGARTEN.

BY ELMER GATES, M. D.

I HAVE been asked to state in a few pages some of the simplest applications of the results of my psychologic and psychurgic experiments to the methods of the kindergarten. In so short an article I cannot do more than explain, in untechnical terms, several of those most important general principles which may easily be applied by the teacher, and to indicate still more briefly the kind of experimental evidence upon which these principles are based, reserving for a subsequent explanation a description of the apparatus and rules for putting these principles most successfully into school-room practice.

Psychology is the science of mind. Since the days of Fechner, Helmholtz, and Wundt, the mind has been studied experimentally, and the sciences of physiological psychology and psycho-physics have arisen. But, in the broadest sense, I mean by psychology the science of living things. All living things have minds, and it is that which distinguishes them from inanimate things. The lowest known living organisms,—simple unicellular lumps of protoplasm like the amoeba, and all other microbes, can feel, and *feeling* is distinctively a *mental* phenomenon; and the same is true of plants and animals. Cells can *adapt acts to ends*; and that is characteristically a mental process. Mind, as far as science is aware, is manifested only in organic structures; the amount of mind manifested depends upon the kind and complexity of the structure and upon the environmental relations, etc. Hence if we desire to understand mind, we must study it as it is manifested in all kinds of organisms and environments. Experimentally, we can vary (a) the environmental conditions and (b) the organic structures by rapid methods of evolution and retrogression, and (c) the mental activities; and by thus varying in each of these three classes of phenomena one condition at a time, we

can determine the effect each condition has upon all or any of the others. Psychology is thus seen to be coëxtensive with biology, and to include it. When we shall have carefully ascertained the effect of each environmental condition and of each kind of organic structure upon the manifestation of mind; and when we shall have applied the same methods to social groups of individuals; and when we shall have experimentally determined the effect of each mental activity upon the organism, and upon the environment, and upon social groups of individuals;—then we shall have accumulated the data for an Objective Psychology; and when the same general methods shall have been applied by the pupil to his or her own mind as known introspectively to the pupil alone, then that pupil will have the data for a Subjective Psychology. But all these data belong to the science of mind, and in addition to their scientific value, should lead to some applications to human affairs; that is, out of the *science* of psychology there should develop an *art* of psychology. These psychologic data should teach us how to make a better and more effective use of the mind in daily life, education, invention, and so forth. Now, to this art of *getting more mind* and of *using the mind*, I have given the name of Psychurgy. Psychology is the Science of Mind, and Psychurgy is the Art of Mentation. "Mind" is a noun; and as we have no corresponding verb, we have to use the word "mentation," to express the idea of mind in action.

Psychurgy has a startling message for the world,—a message that would be wholly incredible were it not for the fact that it is founded upon indubitable experimental data that any one can repeat. The message is that any human being can get, or embody, by a simple process of brain-building, more mind than he at present possesses. More mind,—what does that



mean? It means more of that which does all that is done in the world! It is the mind that discovers and creates every part and every science; it is the mind that invents, and knows, and enjoys, and does, all that we do. It is the mind that learns, and the mind that applies the learning; and the getting of more mind means the easier and quicker and better doing of all that we may attempt to do. More mind means more intellect, better affections and emotions, and a more potent moral nature, and more skill, and more success in all we undertake. To get more mind means to get more of that which makes all things more attainable to us. How can I prove that more mind can be given to a living being? I will tell you.

I caused three shepherd puppies to be born in darkness and to be kept in complete darkness until they were one year old; and at the same time I caused four other shepherd puppies to be raised by a farmer in the usual way, without suppression or training, until they were one year old; and at the same time I caused five other shepherd puppies to be trained in the systematic and equal mentation of every phase of the seeing-functions for one year; and then I had them all killed with chloroform, and I examined their brains chemically and microscopically. And what do you think I found? It had previously been taught that mental activity leaves no chemical or physical trace in the brain. I found that by the process of mentation to which I subjected these puppies, I had created in a certain part of their brains a greater number of brain-cells than any dog of that species and age had ever before had, and that these cells were *much larger*, and had more *dendrites* and *filaments*, etc. The dogs that had been kept in the darkness had a less than normal number, and these were smaller in size, and otherwise different. That is, the mentative process created more brain tissue, and gave the dogs more mind! To make a very long story very short, I found that *every conscious mental experience creates in some definite part of the brain a definite brain-structure, the refunctioning*

*of which is essential to the remembrance of that experience.* Thus, every sensation which differs in kind from other sensations creates in some definite part of the cortex of the cerebrum a special cellular structure. The sound-memory-structures are enregistered in the cortex of the temporal lobes, the sight-memory-structures in the occipital lobe in the region of the cuneus, the muscular-memory-structures along the fissure of Rolando, and so on. The mind creates the organic tissues in which it is embodied! This is true not alone in animals and men; I found it to be true even in the lowest known living forms, such as *amoeba*; for when these cells are caused to engage in different mental activities for a long time, there arise in the cells new structures which are different in kind according as the mental activity has been different in kind. Cells feel light, and respond to it by adaptive action, and this feeling and response is mentation; and when they feel cold-impressions and respond to them, the mentation is different; and the cells which are caused to respond repeatedly to cold, develop a kind of structures different from those of the cells which are caused to respond to light. This shows that at the very lowest stage of life, in the physiologic units, the mind-activity builds the body!

Two dogs were trained to discriminate red colors only; two other dogs were trained to distinguish red and green colors only; and two other dogs were trained to distinguish all the colors. When their brains were examined, it was found that the first group had a smaller number of cells in the seeing-areas of their brains than the second group, and the second fewer than the third. Which means that in order to give a dog as much mind in the seeing-areas of the brain as possible, he must be caused to discriminate *all* the colors, and not merely *some* of them. To have more mind, he must have a correspondingly greater amount of brain-structure. To get an additional structure in the seeing-area of his brain, the dog must make an *additional color-discrimination*—he must not merely see the new color, tint,

or shade, or hue; he must discriminate that color from all other colors and *base an activity* on that discrimination.

Two dogs two years old were kept for one month in a room where they could see all colors exposed in full view on the wall; and two others of the same age and species were caused to discriminate between these colors by feeding them under inverted pans which were painted in different colors. Small mouthfuls of meat were placed under some given color, say yellow. The dogs soon learned not to waste time in turning over any but yellow pans for the coveted morsel. When yellow had been learned, the meat was placed under some other color; and so on, until all the colors, hues, tints, and shades, had been discriminated, and an activity based thereon. This was kept up one month, and the dogs were two years old when I began. The trained dogs had, approximately, twenty times the greater number of brain-cells in the seeing-areas, as compared with the dogs that had simply been kept in the presence of the same colors, hues, tints, and shades! A word to the wise is sufficient,—so runs the proverb,—but my experience is that it takes more than a word, more than any number of words—it takes laboratory training to do this well.

A dog that has not seen any color but red with its tints and shades, will lack in its brain those structures which would have been there if it had seen the other colors with their tints and shades; that is, the dog will have less mind and a less number of brain-cells in that area of its brain than it might have had! Some parts of its seeing-cortex will remain fallow. That part of the universe, of the not-self, of the macrocosm, will not be represented in that dog's mind; and that dog will go through life with that part of the brain and that corresponding part of the omnocosm not functioning in its consciousness!

And what is true of the dog is true of a human child—a child should have all the structures in its brain that it can get, normally, and no parts of its cortex fallow, no portion of nature unrepresented in its ma-

chinery of mentation. The *mind* of a child is *all* of the child—its mind is all it has—take away its mind, and what is left? Therefore give it more mind, and you will give it the greatest of all possible gifts.

How shall you do it?

It would require a large book to tell you, but I can give you a little practical idea of the method in this article. To give a child all the brain structures in the seeing-areas that it can hope to get through the exercise of the first stage of mentation in that area—the sensation-stage—it will be necessary for that child, not merely to see all of the colors, hues, shades, and tints, but to discriminate between each of them and all the others, and also to base an activity upon each such a discrimination. These are two of the general principles to which I alluded at the beginning of this article:

I. In the first stage of brain-building—the sensation-stage—the child should as early in life as possible be caused to discriminate between each recognizable difference of color—pitch, hue, tint, and shade,—and all the other color-pitches, hues, tints, and shades; and to discriminate between each recognizable difference of sound—pitch, amplitude, tone-quality, cadence, melodic succession, and chordal synthesis, and every other sound-pitch, amplitude, tone-quality, etc.; and to discriminate between each recognizable difference of pleasurable and healthful taste, and every other one; and to discriminate between each recognizable difference of healthful smells, and each other smell; to discriminate, in a similar manner between touches, in their recognizable differences of intensity and locality and comparative closeness; and the same for warm-temperature sensations; and for cold-temperature sensations; and the same for muscular sensations, until each muscle has been felt to move, and to move with different degrees of energy and speed and in different directions. Briefly, *give to the child every sensation-memory-structure that it can get from each of the eight classes of sensory nerves, omitting not one recognizable sensation-difference in any of the senses.*

To accomplish this well for the eye, requires special apparatus. It requires a tri-prism movable-spectrum photometer to exhibit all the pitches of each of the seven spectral colors, and each of the hues of these colors, and the tints and shades of these colors and hues—over two millions of recognizable differences; and they can all be passed in review in ten minutes, when necessary. In default of such a device, two Maxwell color-wheels may be used to make the different tints and shades and hues of those particular pitches of color which the disks happen to represent, showing the child all of the recognizable tint- and shade-differences, and hues of those particular pitches. If by means of three prisms you project upon the whitened wall of a darkened room three solar spectra, juxtaposed side by side, you will, by moving one of these spectra up and down relative to the others, be able to let the child compare *all* the color-pitch differences. Then by superimposing one part of a spectrum over another, and by varying the amount of light and darkness, you will be able to produce all the tints, shades, and hues, of all pitches of color. By covering with a cardboard those parts of the spectrum which are not to be observed, you will aid the child in the attempt. I am constructing such an apparatus with gratings instead of prisms. By disks and a color-wheel, only some of the pitches can be shown, because it would be impracticable to make as many disks as there are recognizable pitches of color, and it would take too long a time to make the changes of the disks on the wheel to show the pitches and hues. Let us suppose that there are only 100 color-pitches recognizable, and only 300 dual hues, and only 3000 of the triple hues; then, to exhibit these on the color-wheel (allowing three minutes to adjust the disks and turn the wheel and look at it a moment), would require 175 hours! With a tri-prism apparatus, all these can be shown in half an hour by any teacher who will practise a little in juxtaposing and superimposing several well-diffracted spectra! But to exhibit the at least forty recognizable tints

and shades of the above-mentioned pitches, and hues, would require forty times 175 hours. By varying the amount of light and shade in the room, the teacher can in a few hours exhibit all the lights and shades of the pitches and hues.

To accomplish the same thing for the ear requires also special apparatus, such as instruments for making all the pitches of sound, without skipping intermediate pitches, as the piano and organ do; and means for making all the pleasant amplitudes of each of these pitches; and means for making all the tone-qualities of each of these pitches by varying the relative loudness of different over-tones in each of these pitches; and means for making chordal combinations on each of these pitches and with each tone-quality thereof. I have devised an electric sonometer which accomplishes this; but the teacher can by means of a wire sonometer, or stretched strings, produce most of the pitches by the process known as the glide, and also differences of amplitude, and to a small extent differences of tone-quality, by making a given pitch with different musical instruments. Do not use instruments with fixed keys or holes, because these do not give nearly all of the pitches within their range, but omit vastly more pitches than they produce. Thus if  $c'$  on the piano be 512 oscillations per second, then, between that and its octave  $c''$  there will be 512 pitches possible; but the piano gives only 12 of them! Between  $c''$  and  $c'''$  the piano and organ give only 12 out of 1024 possible pitches. In instruments as at present known, the tone-quality cannot be varied in any given note, and without special facilities the teacher cannot hope to do more than give the pitches and amplitudes and chords. To omit from the child's training most of the recognizable sound-pitches is to omit from its brain most of the cerebral memory-structures which it might have had in its hearing-areas; it is to leave unrepresented in its mentation that portion of the cosmos; and it is to produce in that part of the child's mind-organism an unsymmetrical and ataxic and incomplete mind-embodiment. The omitted structures pre-

vent that unity and wholeness in the brain-building which it is the object of brain-building to produce. If all the pitches of sound have been heard several times in gliding succession, and then with successively larger intervals until the chromatic and diatonic scales have been heard, there will be anatomical and psychologic totality and organic oneness in the memory-structures and consciousness. But that *self-active unity* will be broken if great groups of the pitches have never been heard. The same is true if great groups of color-pitches and hues have never been seen, and the same is true of all the other senses; but I cannot in this article refer to the methods of training them.

It will be noticed that this first general principle of mind-embodiment requires a totality or unity of memory-structures, so that there shall be no gaps in the representation of the macrocosm in the microcosm—so that no part of the cosmos shall be unrepresented in the mentation as far as the Sensation Stage of Brain-building is concerned. I am not dealing in this paper with the other and higher stages of mind-building, such as the image-stage, the idea-stage, the concept-stage, the reason-stage, the thought-stage, and so on, but only with the sensation-stage. This first principle requires that all the distinguishable sensations shall be discriminated by the child; but it is also required that these sensations shall be given in a certain order or natural grouping, from the lowest pitch of sound and color to the highest, and so on; and this leads us to the next principle.

II. In the first stage of brain-building, the child should have its sensation-memories *enregistered in a natural order and in taxonomic groups*; that is, one great natural group of memories should be given to the child at a time, and that group should be completed before beginning another group, and the order and classification of these memories should correspond to the arrangement as found in nature. Any kind of artificial arrangement or grouping is a simple taxis; if the classification is erroneous, it is dystaxis; if there is no classification, but a chaos, it is ataxis; if the

classification is true,—that is, if it corresponds to the universe as far as known,—it is eutaxis. To jumble all kinds of color-pitches and hues and tints into one lesson is to produce dystaxic or ataxic brain-building; but to teach the color-pitches of red in their normal order from lowest to highest so as to omit none of the recognizable pitch-differences, and at the same lesson-hour to give the tints and shades of those pitches; and then to proceed in the same way to the other colors; and then to take up the hues and their tints and shades, not mixing in the same lesson a few pitches of this color and a few of that and several hues of this and several tints of that, giving no one group complete at a time, is to achieve eutaxic brain-building. Education is at present chiefly ataxic. The object of eutaxic mind-embodiment is to produce a normal and complete brain and a wholeness of consciousness. If the machinery of mentation is built orderly, with no parts of the mechanism missing, then the mind can completely manifest its possibilities. If the structures are dystaxic, so will the mentation be dystaxic. I cannot enter into an explanation of the full meaning of eutaxy, in this paper.

III. In the first stage of mind-embodiment the child should have the eutaxic enregistration take place at the *same hour* each day, so as to create a periodicity of vasomotor blood supply to that portion of the brain, and a periodicity of metabolism, etc. Thus, when building the seeing-areas the lesson should be given precisely at the same hour each day, so that by habit a full supply of nutrient blood may furnish the materials for the creation of cellular structures, and so that the periodicity of metabolic stimulus may at that time be dominant. If at the same hour daily you bring into activity other parts of the brain, such as the hearing-areas, or muscular-areas, then the metabolism and blood-supply will not be centred at the one place as they should be for the best results, and dominancy of consciousness will be scattered. Of course the child should always have slept and rested well the previous night, and should have been well nourish-

ed, and happy. If these conditions cannot be obtained, better not give the lesson than to make weak brain-structures or vitiate them with the poisonous toxastates produced by the evil emotions.

IV. The enregistrations of the memory-structures in any eutaxic group should be repeated once each day for at least six days, in order to produce fully-developed structural changes that will not atrophy or become submerged in a short time, and so as to fully develop the auxiliary structural growths upon which associative connections depend. A single enregistration of a given sensation is not enough; only five or six repetitions can produce an efficiently functioning structure capable of doing duty for a lifetime.

V. The enregistration of sensation-memories of any one eutaxic group, should take place under the influence of an equal degree of interest or attention so as to render *each sensation-memory equally dominant in consciousness* with all the others of that group. Otherwise, some of these memories will stand out in bold relief, and others will not arise in consciousness, and the inexorable result will be abnormal mentation and untrue conclusions: the life mentation of that child will to that extent be defective—the missing memories will not influence its judgments, and its ideas will be dystaxic. The same law applies to the different sensory groups. All should be equally dominant in consciousness. Just stop and think how far this law has not been realized in our educational methods!

VI. The enregistration of each eutaxic group of sensations should take place at that ontogenetic periodicity of the child's evolutionary development when the corresponding capacities *first arrive* and when the cravings for that kind of mental activities first manifest themselves. Thus the baby can appreciate touches and temperatures before it can discriminate smells and colors; and so on. When the capacity and craving first arises is the periodic time when the blood through normal vaso-motor dominancy is first surging through those parts of the brain, and eutaxic growth is easiest effected.

VII. Every enregistration should be wholly anabolic. I will explain: the chemical changes which take place within the cell substances of those cells out of which our whole body is built,—which constitute the growth and recuperation of the cells—are called metabolism. Cells take food out of the blood, assimilate it, excrete the refuse matter, manufacture the energy of life and repair the waste of fatigue; these changes are called metabolism. If these cells are living at a profit, that is, if they are accumulating nutriment and growth and energy, the process is called anabolism; and if the reverse process takes place through fatigue or disease, it is called katabolism. Now I have discovered that the *evil and depressing emotions augment katabolism*; and when they are prolonged and intense there result poisonous autotoxic compounds which I have named *toxastates*. When the *good and cheerful emotions are intense and prolonged, there result an augmented anabolism*, and the production of superabundant energy and the nutritive products which are stored for after use, which compounds I have named *eunastates*. All painful and disagreeable sensations are katabolic, and fill the cells and blood with toxastates, and the memory-structure produced, recreates these poisons whenever it refunctions. Hence, avoid all unpleasant sensations, and if one is produced never allow its repetition. Make all the sensation-enregistrations as pleasant as possible, and make them only while the child is happy, and never when the child is unhappy.

VIII. In enregistering sensation-memories, always cause the child to base an activity upon the discrimination of each sensation for all others of its eutaxic class. This is the most important law of the series; omit it, and no enregistrations will be made that are worth having. I should write a whole article upon this subject, but a few explanations will suffice. You are never certain that a discrimination has been made until an activity has been based upon that discrimination. Place upon the floor, for example, twenty green boxes and twenty red boxes of the same size and

shape, and put into each of the red boxes a small bit of cake. The stupidest child will after several repetitions learn to open only the red boxes; that is, an activity based upon the actual discrimination between red and green, tells you that the discrimination has actually been made, and the memory-structure that results will be intellectual and conative. A normal and natural act of conduct has thereby been based upon the discrimination, and the motor-memories have been thus associated with the intellectual memories, and if the process had been a *play-activity*, it will also acquire the normal emotive, anabolic memories. Long before a child can talk, it can be made to stick pennies through a crack, or put blocks through a hole in the top of a box. Make a round hole and a square hole in the box and fit two blocks to them—the round blocks will not pass through the square hole, and the square block will not pass through the round hole. After some days the very young child will look at the blocks and then at the holes, and will deliberately put the round block into the round hole—that is, it has discriminated between two geometrical images, and demonstrated to you that fact by basing a normal activity thereon. But this belongs to the second stage of brain-building—that of image-building. To return to the cake and the colored boxes; suppose that as soon as the child learns to seek for cake in boxes of a certain color, you take instead of food a favorite rattle, hide it in the red box, and place the red box among boxes of all the colors; then place the red box among other red boxes of much lighter tints and shades, until finally you have several red boxes containing cake, mixed with red boxes not containing cake, and of a *five-per-cent. lighter or darker red*. If the child can find the boxes containing the cake without mistake, it will have discriminated between a five-per-cent. difference in the shade or tint of red; if you still diminish this difference you will finally reach the child's "least noticeable difference" for reds. A child can in a hundred ways be caused to base an activity

on each sensory discrimination; and only when it has done so, has that brain-structure been properly placed in the brain.

The Froebelian Kindergarten will notice that we have here experimentally demonstrated that only the *self-activity* of the mind can create brain-structures; that Froebel's idea of teaching by *wholes* was a first glimpse into a very profound law; and that *play-activities* are not merely desirable, but that a pleasant anabolic activity must be coupled with every intellectual acquisition.

In conclusion, I take pleasure in referring to the recent experiments by Professor Aurelio Lui in Stephano's laboratory in Italy (an account of which may be found in the *Revista Sperimentale di Frenatria*, volume 20 [1894], page 218, and volume 12, page 27), in which he has shown by experiments upon animals that as they more and more acquire the capacity for walking they get a greater number of motor-cells in the brain, and that these cells are larger and more complex in their structure, thus corroborating my much earlier experiments in brain-building.

It seems to me that the noblest profession is that of teaching and training children; and I predict that in the not very remote future, properly-prepared teachers will receive high salaries for taking care of children during the pre-kindergarten stage, or "cradle curriculum," and through the kindergarten stage and during the primary school stage; for it is during these stages that the most important part of mind-building and moral training can be effected. For this task, the fullest preparation and the supremest self-control and the widest knowledge and the purest life are needed—and these things cannot be had for a meagre salary.

Of course there is a still more important stage of training—the stage that lasts nine months during gestation—and this devolves upon the parents, and chiefly upon the mother; but of this I will not now speak. And there is one *still more important stage*—that which precedes the creation of the child. My experiments on Guinea-pigs demonstrate that only those

mental qualities are transmitted to a child which have *previously to the creation of the child been builded in the brain as brain-structures*; and it is thus in the power of the parents to bequeath to the child all the normal mental capacities. Those intellectual, moral, and conative qualities which you do not desire to transmit to the child, can be prevented from being so transmitted by the process of curing immoralities which I was fortunate enough to discover. It consists in finding out just what kind of evil memory-structures the parents have—what wrong sensation-memories, what wrong image-memories, what wrong concept-memories, what wrong idea-memories, what wrong emotion-memories, etc.; and then in building in these same parts of the brain another group of good memory-

structures, until you have therein a *hundred times as many good memory-structures as you had bad memories*; and then for five or six months keeping the good structures functionally active *oftener each day than the parents will have an opportunity to exercise the bad ones*. The result is growth of the good structures, and atrophy of the bad ones—submergence of the evil conscious states and dominancy of the good states. Being physiologically, anatomically, and psychologically remade, those undesirable structures and traits will not be hereditarily acquired by the child to such a large extent as without this training; and with a longer training the inheritance will be wholly prevented.

These facts are optimistic, and prophetic of a glorious future for the race.

