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CHAPTER 8
***More Mind: Mind-Embodiment
and Brain-Building***

We are at last arriving at a physiological basis for a new education. It is the only one that attacks the real problem in a way that offers anything like a chance for the settlement of the educational question, and every day that becomes more pressing.

—A. E. DOLBEAR, Professor of Physics, Tufts College

That the individual could get more mind Elmer Gates did not doubt, because the progress already made in developing his own faculties had given him augmented mental ability as well as greater mental content and capacity. The art of embodying more and better mind was gradually shaping up as getting greater mental ability by the psychotaxic trainings, by his concept of “psychal quantity,” and by his brain-building experiments on animals. It was of these experimental results that Professor Dolbear wrote so enthusiastically, in 1895. Quantity or magnitude had not been applied to the mind, but the discovery of psychal quantity was the next step in the art of getting more mind. Difference in intensity of conscious states was one kind, in duration or number another, but psychotaxic

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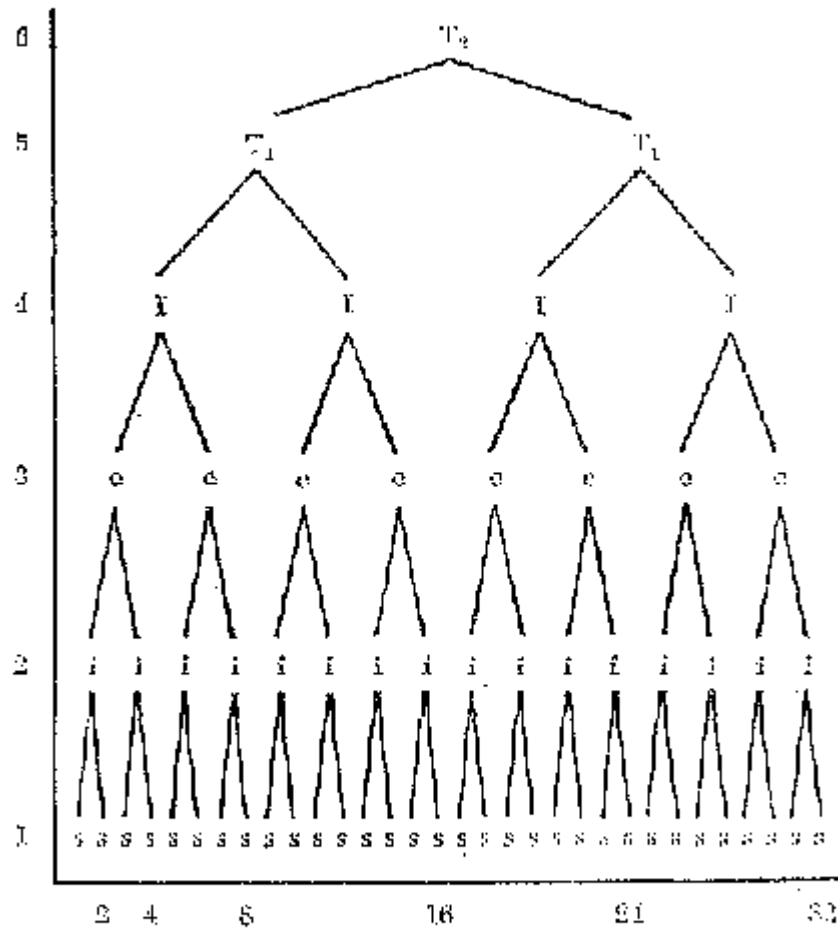
quantity was a new and special kind of psychal quantity. It has two factors: width and height of the psychotaxic “pyramid.” Intellectively the memory-content begins with sensory data out of which the mind integratively constructs an image of an object; out of images it segregatively constructs a concept of a group of objects; by discovering relations between two or more concepts it arrives at an idea; by finding a generalization true to two or more ideas it obtains a thought of the first degree; between two or more thoughts of the first degree it finds a thought of the second degree; and so on to several higher degrees. (Subperceptual and other steps are omitted for simplification.) This analysis, previously described (in Chapter 6), was illustrated in some of Gates’ lectures by the diagram of the intellectual pyramid on the following page.

Referring to the diagram, each of the images (i) arises out of at least two sensations (s); an image may be considered two steps in height and two units in width, diagrammatically. Each concept (c) arises out of at least two images; a concept is three-steps in height and four units in width. An idea (I) arises out of two concepts, four images, and at least eight sensations, so an idea is four steps in

height and eight units in width and contains eight units of the first step, four of the second, two of the third, and one of the fourth. An image is a larger psychotaxic quantity than a sensation, a concept larger than an image, an idea larger than a concept; and all in the two senses of width and height. A first-degree thought (T1) arises out of at least two ideas and is five steps in height and at least sixteen units in width; a second-degree thought (T2) arises out of at least two first-degree thoughts and is six steps in height and at least thirty-two units in width.

To remember an idea is to embody more mind than to remember a concept. The person who has the greatest number of true ideas has the most mind as regards ideation, and more especially so if by Mind Art methods he can ideate more rapidly, easily, and vividly, and still more especially if he attains more new and true ideas. A man with a thousand ideas in chemistry

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PSYCHAL QUANTITY
Simplified Diagram of the Intellections

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and ten in mathematics and one in electricity has less mind intellectually than one who has a thousand ideas about each. A thought represents knowledge about a larger group of phenomena than does an idea; it covers a larger domain of nature; it represents a greater complexity of structural change enregistered in the brain and integratively a higher conscious generalization. I anatomically, psychologically, and environmentally represents a smaller quantitative interrelation between the two ideas than would two such thoughts of equal rank.

“Mind is an adaption of self to environment,” Gates further explained: “an inward urging and choice of feeling, accompanied

by pleasure and pain, drives and leads; through intellections, knowledge is gained of things and their relations, of opportunities and dangers (as interpreted by feeling); and activities are volitionally carried out which feeling has chosen. Through environmental stimuli is gained a knowledge of relations to outward things, and this knowledge, these feelings, these conations, by which the organism adapts are *mental processes*—the capacity is a mental power.”

The discovery of brain-building and mind-embodiment came about not only because Gates shrank from vivisection but because he realized that the study of functionalization in the brain of animals—as then carried out by cutting away part of the brain to find what mental faculty would be missing or affected—was certain to lead to wrong conclusions. Cutting out an area of the cortex would produce pathological and abnormal results, destroy the circulation to other areas, and cut off connections to them through tracts of associated fibers. His psychologic research was planned to answer the questions: Does mind activity make any observable growth changes in the brain? Does unusual mental activity produce an unusual structural or chemical difference in any part of the brain?

He regretted deeply that more was not known about the mind and its relation to the body. He was “tired of theories,” so he studied the subject with the aid of the art of mind-using. He attained the insight that led to the new method of research

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and plan of the animal experiments in brain-building. He set to work to become familiar with anatomy, histology, and microscopy so as to be ready for the work as soon as he could obtain facilities; and he sought the help of specialists. This work led to the discovery of brain-building, which confirmed his judgment that mind always requires an organism for its manifestation; and science knows of no instance of mental phenomena occurring without being manifested by a living body.

His new method of research was to give some individuals of a selected species of trainable animal an extraordinary training in the normal use of some one mental function, far beyond that ever before received by that species; to allow another comparable group to go untrained, by their usual life; and to deprive another group of the opportunity to use this function. The brains of these three groups would then be examined to see if differences in amount of mental content (or psychal quantity) would produce corresponding differences in complexity of the brain structure in which these memories were enregistered. After some consideration he chose a faculty of which the animal could be deprived without mutilation:

sight. He could make a room from which light could be excluded (he made the "darkest room in the world" the press reported). It was not easy to make a soundless room, and there were no other mental faculties that could be so easily suppressed. After much preliminary work he chose to work with collies, rabbits, and guinea pigs.

For example, experiments were made on three groups of collies by color training. Group A were given an unusual and extraordinary training of the seeing functions. It took several years to find out how to do the training. Gates saw after many trials that the dog must be made to discriminate between as many color differences as within its mental capacity; that each must be based on a sight stimulus of just sufficient intensity and duration to make an adequate sense impression, and be discriminated; that indication of each must be based on some conscious bodily movement or conation, for instance the turning over of only green pans in a collection of many colored ones, all smeared

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with fresh meat, to find a bit of meat under them. The dog would soon learn to turn over only the green pans; then the color would be changed until all distinguishable steps of the seven primary colors had been discriminated. Then the hues with their shades and tints were tested . . . then the least noticeable differences, and so on.

It took too long to wash the pans to keep them from smelling (there were a thousand pans in a room thirty-five by ninety feet), so all were fastened down with meat under them except the selected color. Another method used colored flap-doors hinged at the top, with only those of the selected color opening. A variation for older dogs used colored plaques of metal, like a large checkerboard, all being charged with an induction coil to give a slight shock to the dog's moistened feet except the selected color. Two collies became proficient in operating a device with piano-like keys of selected color. For a year-in some cases a year and a half-the puppies would make fifty to five hundred color discriminations daily, until one group of six had made over 180,000 as evidenced by correct conations. Gates had to train himself to keep up with them. Iridescences, opacities, transparencies, areas of two or three colors, and differently shaped color areas were also discriminated. He had not trained more than three classes of dogs when he found they would remember details in greater number and for a longer time if the color differences were presented in classic groups according to their physico-chemical and psychological relations. Certain kinds of mental activity should be performed at the same periods each day; and a

tired dog did not learn so quickly nor remember so readily as one with surplus energy; the fatigue point was lowered by systematically interrupted sleep, and so on.

Group B consisted of eleven collies that had had an ordinary life on a farm. Group C consisted of four collies, two from one litter and two from another, whose mothers had been placed in the darkroom a few weeks before the puppies were born, and they saw no light for a year and a half.

It was emotionally not easy to have these dogs chloroformed

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and killed to have their brains preserved for examination. The art of making examinations of the cellular structure of brains was in its infancy; still more so, Gates pointed out, was the chemical examination of brain tissues, so stains were depended on without knowing the chemical changes produced. But when two areas stained differently with the same stain, a chemical difference was indicated. He fully convinced himself (he was not trying to convince anyone else) that differences of mind-activity did create chemical differences in the cellular brain tissues and that dogs of Group A had a greater number of well-developed pyramidal and granular (easily seen) brain cells per unit area of cortex in the region of the cerebellum and of the cuneus than had Group B, and a far greater number than Group C. At first he considered that a number of new cells were created, but later he decided that incipient and undeveloped cells were structurally developed. Of course some dogs of the same litter inherited more well-developed brain cells than others, but none inherited as many as a trained dog. The unavoidable conclusion was that only a few of the inherited brain-cells in any area are ever developed; most of the mind that any animal might have developed remains unembodied and most of the brain undeveloped. In addition, he was certain that beyond any ordinary internal structural development, these special mind activities actually created new and additional internal structures, physical and chemical, in the cell body a conclusion confirmed by his experiments on unicellular organisms.

Similar trainings with other animals and other functions, and post-mortem examination of the brains of people who had not used certain mental functions while alive, led to his conclusion that conscious mental experiences created in definite parts of the brain structural enregistrements that were the memories of those experiences. These experiments showed that mind is causatively connected with the organism, that the experiences of consciousness embody themselves as organic structures, that the individual can by conscious processing be given more brains and more mind.

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Gates took pains to point out that these researches were made when he had experimental facilities of the most meager kind, but just sufficient. He wished to make it clear that the Mind Art was based on established fact and experience and was not necessarily dependent on any interpretation of his. "The art of mentation," he wrote, "was developed and practiced before I had any knowledge of brain-building; and it has no necessary connection with the value or verity of the mentative methods. Had these experiments on animals never been made, the main practical outline of the Mind-art would have been formulated, and in nearly the same way, from my experimental studies of each kind of mental ability in myself and others while engaged in successful kinds of mental work, and my inventory of total rememberable content of minds. "The logical principle of consistence has been strongly operative, and many other converging lines of evidence have since led to the same conclusions. However, my brain-building experiments enabled me to explain to my satisfaction how the getting of more mind and brain takes place. Further study may modify some of my corollaries, but I do not think that the general conclusion that mind activity differentiates and integrates nervous structures and thus embodies itself in structure, will be modified."

Whatever the interpretation, he further concluded that functional activity produces structural growth and every conscious mental activity produces molecular and structural changes in the brain and other parts of the organism that are revivable as a memory; that memories belonging to the same class are enregistered approximately in the same parts of the brain, thus creating more structural mind-embodiment in those parts; that those parts can be associatively integrated into wholes, including memories of all kinds of knowledge and all departments of nature, making a comprehensive mind and personality. Each group of associatively integrated memories thus added to the brain is the acquisition of more mind and better mind-organs, and the basis from which to educe a moral disposition and attain all the higher powers of mind.

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Gates first tentatively described his results in 1890 (fifteen years after starting his studies), explained them more fully in 1892 and 1893, and first lectured publicly and published interviews in 1894. Extensive press notices showed the widespread interest of the public.

One of the first confirmations of his results came from Europe in 1894. (Dr. Aurelio Lui, of Professor Stephano's laboratory in Milan, published researches showing that as animals acquire more

skill and experience in walking there is a corresponding increase of certain cellular elements in the cerebrum.) But the main confirmation came from the rapid progress of physiology, notably from the observations of practicing physicians, Gates wrote thirteen years later. One of them, W. Hanna Thompson, *Brains and Personality*, Dodd, Mead, 1907, concluded:

“As none of these mental faculties, including speech, were connected with the brain-matter at birth, it follows that they were created by the individual himself anatomically modifying his own brain. . . .Here surely we come upon a most impressive fact; namely, that by constant repetition of a given stimulus we can effect a permanent anatomical change in our brain stuff, which will add a specific and remarkable cerebral function to that Place which it never had before....Another important conclusion is that we can make our brains, so far as special mental functions or aptitudes are concerned, if only we have the wills strong enough to take the trouble.”

It is mental activity, as well as survival of the fittest, that develops structures in brain and body, Gates further remarked. It is not mere physical activity of the bodily organs: it is the mental activity of discriminating between the touches, pressures, muscular feelings, tints, shades and hues, and other stimuli that produces the increase in structural elements of the cortex and the rest of the body. Gates found that when a person had attained a certain capacity, or limit, in discriminating, after several

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times repeating that limit during a practice period and waiting a day, he could improve his performance and could discriminate a smaller difference. For example, if he could distinguish a shade of red that was 4 per-cent darker than the original red shade but could not quite distinguish a shade only 3 percent darker he found that he could after practice discriminate a little less than this 1 percent difference, perhaps 1/10-1/20 percent less. The amount depended on his mental quality and training. If this improved discrimination was repeated several times, and a day allowed to pass, on the next trial another step could be taken, and so on, each becoming a temporary standard of skill and serving as a new starting point. Gates considered he had amply demonstrated this law of development of “discriminative capacity,” which was the kind of mind activity that would create additional cellular structures in the brain, and was the basis for skill-trainings.

This study of the effects of mind on organism led him to discover the relationship between morphology and mental

activities. With limited facilities he studied the effect of selective propagation upon lower organisms. He produced rapid structural evolution by the method followed by horticulturists, so well described by Wallace and Darwin, but with a wholly different purpose: to note what mental activities arose with the appearance of structural changes. He likewise produced retrogression and noted the disappearance of mental activities with the disappearance of structures. It was the first time that experimental evolution had been applied to psychologic experiment; it was a study of psychogenesis. When variation is produced by survival, an adaptation may be produced that is not necessarily a higher order of mind. For instance, an infusorian born with a thicker and more pigmented skin on its back would be protected from a severity of light that destroyed others of that group. When it was allowed to propagate into millions of individuals, and then all were destroyed except for a few by increasing the intensity of light, after some generations the result was a carapace, or shell-like covering, fitting those surviving individuals to live in that

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particular environment without giving them increased mental capacity. When, however, those individuals were successively saved that could most quickly get out of the intense light projected upon them, a species was produced that was capable of surviving because of mental superiority. This was the true kind of evolution, by the acquisition of normal mental content and skill in overcoming adverse environmental conditions; and it consisted in learning introspectively the truth about the opportunities and dangers of the environment, in feeling emotionally its utility, beauty, and other qualities, and in conatively realizing or acting out the truth of such knowledge. That is, evolution is mind-embodiment regulated by knowledge. Gates clearly saw by this line of research based on many experiments with lower organisms that evolution could be rationally directed and not left to the more chaotic and slower methods of survival of the fittest. Some of his experiments described in the lecture before the Philosophical Society of Washington in 1894 were appreciated by many of his audience—Lester Ward, for instance, who paid tribute to him from the floor, praising the importance and novelty of his work.

That mental content is an initiative factor in evolution was a conclusion that Gates considered important additional evidence of mind-embodiment. When an animal by accidental variation acquires new mental aptness of any kind, or is forced to cope with new kinds of enemies or opportunities or environment, it thereby acquires a new class of mental experience. This is a new kind of mental content between the elements of which relations and

associations arise, giving new judgments, impulses, and motives, thus modifying its reaction to the environment. This mental content, containing new facts, images, concepts, and ideas, is a new source of activities by which adaptations are made differently from before. It is the mind-factor in evolution, causative of progress, of morphology through modified nervous growth.

Gates was also impressed by his conclusion that cells are the psychologic as well as the anatomic units of an organism. His

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experiments demonstrated that cells are alive because they can feel stimuli and adapt acts to ends; since only mind has this property, cells, then, have minds and are alive because of it. The functioning of an organ consists in the combined functionings of its cells, and these function mentally. To change the functioning of an organ it is therefore necessary to modify the mentation of its individual cells.

His conviction that evolution is mind-embodiment (as pointed out in his article in the *Monist*, July 1895, for instance) was the outcome of long-continued investigation, and was a fruitful influence in his work. He once expressed it this way: "External stimuli could have no evolutionary effect upon a dead thing; it can produce response only in a thing that is alive. That which in a cell responds is that which can feel and adapt, and that is a mental characteristic. This response is a self-activity, that is, a mental activity, and when repeated produces structural change in the cell. Hence, it is not the stimulus that produces growth, but the activity that responds and adapts. To increase the functional differentiation involves the concomitant differentiation in the functioning organ; else functions could exist without structures. The *whole course of evolution* is an ascending anatomical complexity of organism corresponding to the ascending psychological complexity of functioning.

"My experiments show that when two groups of cellular organisms of the lowest kind were caused to functionate in response to two kinds of stimuli different structural changes arose in them, according as their mental activities differed. There is also conclusive pathological evidence that lesion of certain parts of the brain produces loss of certain memories; that is, memories are physically embodied, and therefore consciousness by accumulating experience builds brain and mind simultaneously. More mind is always accompanied by more structure. Evolution is mind-embodiment; increased mental capacity is always accompanied by an equally augmented structural complexity. More mind is the goal of evolution. To get more mind and learn how to use it seems to be the fundamental opportunity and duty and

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purpose of life. To get less and less mind and to gradually lose the power to use it is the direct opposite of all hope and aspiration.

“When the actual knowledge-data of a science have been collected and learned, then the mental training of the intellectual functions in that domain can be properly undertaken; and the next step in the biological growth of that brain, the next step in the psychological growth of that mind, in the evolutionary progress of the race in that science, and in the logical development of that science, will be one and the same. It will be practically impossible for a pupil not to take that step if he apply the mentative art. In these principles we have the educational curriculum outlined.”

Mind-embodiment, or brain-building, consists in the enregistration of psychotaxic data as intellectual mental content, as esthetic content, and as conative habits and skills. It is one of the cornerstones of an improved education, Gates emphasized. Every remembered conscious experience that the mind gets with itself or with environment is a datum; and if such data are psychologically classified, they are psychotaxic data. Through psychotaxic mind-building the individual gets *more mind*, in the sense not only of increased number of elements in cells and fibers that alone constitute a mind-mechanism but also of a more normal and taxonomic mind. Mind-building is comprised of the up-building of the intellect, the feelings and emotions, and the voluntary habits.

Intellect-building consists in causing consciousness to acquire by its own direct experience the psychotaxic data of the sciences in such a way as to enregister the corresponding memory structures in the brain, thus producing an efficient mentating machine. This method produces a normal mind whose memory content consists in data and brain-structures that are properly arranged (psychotaxically) instead of being chaotically jumbled together, and of conscious states that are true instead of largely false and theoretical. Intellect-building consists in learning the psychotaxic data of a science in a properly equipped laboratory

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capable of showing the phenomena in psychotaxic groups, in such a way that the pupil will systematically enregister all the sensory and image data as brain-structures and as intellectual states; then in enregistering the concepts, then the ideas, and then the thoughts. The pupil will learn nothing dogmatically. He will know from his own experience every fact of that science.

Acquisition of the data of a psychotaxic science is in reality the embodiment of *more mind*. If it were possible to remove its total mental content, there would be no mind left. In most minds a large

part is wholly false, mythical, theoretical, and useless (or unclassified and thus not available for use). By a properly arranged pedagogic outfit of psychotaxic apparatus, his investigations convinced Gates that all the sensations, images, concepts, and ideas of a science could be inductively acquired in so short a time “that it would only arouse disbelief to say how short.” No theory or hypothesis would be used; *all* known facts would be acquired; and the pupil would be skillfully familiar with all the practical technique.

Esthesis-building consists in acquiring the normal feelings, emotions, and sentiments in the same manner. Conation-training is acquiring efficiency and skill in the acts by which knowledge is applied to achieving one’s purposes.

The main value of these discoveries lies in their application to an education that will fit the student for an actual life of usefulness and happiness, Gates emphasized. Before anything is ready to be taught, it must first be tested by all known methods to determine to what extent it is true. Is it a fact? And does the learning of it fit the pupil for discovering other facts, and for an everyday life? Consequently some training should consist in the art of testing knowledge as to its truth, in selecting motives as to their value, and in performing the technical part of his vocation. Then the pupil will be ready for a more direct culture of the esthetic faculty to augment the joys of life, using them as means as well as ends.

Throughout the whole course of development of the Mind

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Art, Gates recognized that the intellectual and even the esthetic processes and states were the outgrowth of an organized and instinctive conatus that is itself an organically specialized form of a cosmic conatus. It became more and more evident that this will to live—this *vis a tergo* and *vis a fronte* of life—can be led to create still other mental faculties; that the main use of intellection is to guide this conatus in marshaling the conscious and subconscious processes; and that all processes promotive of life and truth will become pleasurable and can by training more rapidly be made so.

The diagram of the intellections earlier in this chapter shows the taxonomic range of a simple second-degree thought. If another similar one were placed beside it, and still others representing first or second-degree thoughts, the base of the pyramid would thus widen to include gradually all the phenomena of a science or one domain of nature. If the next higher superunit of a thought were discovered, it would increase the height of the pyramid, and this is the Mind Art way of extending knowledge. If the investigator

were to prefer one portion of the pyramid, he would be developing his brain and mind in a one-sided manner, and results would not represent a logical or taxonomic *whole*. The whole scope of each science should, so far as possible, be developed to a uniform degree. When the pyramid of each science shall have been completed and the higher units of each combined into still higher units and finally into one generalization, there will result a philosophy. A group of mentators among whom a division of labor has taken place may, if they represent the leading minds of the world, hope to arrive at something like a true philosophy or a synthetic science, but that philosophy will extend no further than the taxonomic range of actual knowledge.

An early account of the Mind Art is given in part of a letter Gates wrote in 1883, at age twenty-four, to Dr. William T. Harris, editor of the *Journal of Speculative Philosophy* and later U.S. Commissioner of Education.

“The Mind-art or Mentative Art is the art of more skillfully using the mind in learning, demonstrating, and discovering more

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knowledge, in teaching and learning the sciences and arts, in making inventions and doing creative work, in enjoying and training the feelings and emotions, in acquiring the skills for any specialty, in making a livelihood, and in doing those things for which we have special tastes or ambitions, in living a longer and more complete and happier life. More especially it is the art of getting more mind and learning how to use it more effectively. It is applying the principles of evolution to the individual, and it is, (ambitious program!) taking evolution in hand and directing it. . . .

“The law of evolution is implicit in the biologic and psychologic data upon which the Mind-art is based but it is an extended conception in which the mental content is a causal factor; and the embodiment of more mind and the attainment of its own peculiar satisfaction and development of higher satisfaction are some of the goals. Mind-embodiment in one of its basic phases involves the acquisition of approximately an equal amount of knowledge from each of the sciences if one would be mentally well balanced; and being Bacon-like, the Mind-art says: ‘I have taken all knowledge for my province,’ and each devotee will attempt to live up to that ideal to the extent of his abilities, and will specialize in the sciences and arts which relate to his tastes, livelihood, and predilective career. The mentator will, in learning the sciences, be embodying mind intellectually; he will also wish to normalize his feelings (esthesias) and acquire a full fund of them; and he will want to acquire all the practical arts and skills insofar as he needs them in making a living and attaining his

higher self-development and for doing some service to humanity. He will want more knowledge and more mind and more life, a good moral and ethical character, an all-around and able personality from which immoral and unethical dispositions have been eliminated and he will, for guidance and success, want skill in original ideation and thought.

“The Mind-art requires a new taxonomy or classification of living beings based on their degrees of mental evolution and corresponding degrees of structural development of their nervous

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system—a classification involving the entire range of mental differentiation and integration known to bacteriology, biology, and zoology; also a graded classification of mental states, processes, and persons.”

Dr. Harris wanted to publish this letter but Gates declined, not being ready to come before the public at that time. Later Harris wrote to Gates: “I have a great interest in your labors and great faith in your powers to discover and demonstrate valuable facts and principles in physiological-psychology. We now have the beginnings of a scientific art of research and may expect psychology to increase in importance.”

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