

HOW TO USE YOUR MIND

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A PSYCHOLOGY OF STUDY

BEING A MANUAL FOR THE USE OF STUDENTS AND
TEACHERS IN THE ADMINISTRATION OF
SUPERVISED STUDY

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Preface to the Second Edition

The kindly reception accorded to the first edition of this book has confirmed the author in his conviction that such a book was needed, and has tempted him to bestow additional labor upon it. The chief changes consist in the addition of two new chapters, "Active Imagination," and "How to Develop Interest in a Subject"; the division into two parts of the unwieldy chapter on memory; the addition of readings and exercises at the end of each chapter; the preparation of an analytical table of contents; the correction of the bibliography to date; the addition of an index; and some recasting of phraseology in the interest of clearness and emphasis.

The author gratefully acknowledges the constructive suggestions of reviewers and others who have used the book, and hopes that he has profited by them in this revision.

H.D.K.

April 1, 1921.

Preface to the First Edition

Educational leaders are seeing with increasing clearness the necessity of teaching students not only the subject-matter of study but also methods of study. Teachers are beginning to see that students waste a vast amount of time and form many harmful habits because they do not know how to use their minds. The recognition of this condition is taking the form of the movement toward "supervised study," which attempts to acquaint the student with principles of economy and directness in using his mind. It is generally agreed that there are certain "tricks" which make for mental efficiency, consisting of methods of apperceiving facts, methods of review, devices for arranging work. Some are the fruits of psychological experimentation; others are derived from experience. Many of them can be imparted by instruction, and it is for the purpose of systematizing these and making them available for students that this book is prepared.

The evils of unintelligent and unsupervised study are evident to all who have any connection with modern education. They pervade the entire educational structure from kindergarten through college. In college they are especially apparent in the case of freshmen, who, in addition to the numerous difficulties incident to entrance into the college world, suffer peculiarly because they do not know how to attack the difficult subjects of the curriculum. In recognition of these conditions, special attention is given at The University of Chicago toward supervision of study. All freshmen in the School of Commerce and Administration of the University are given a course in Methods of Study, in which practical discussions and demonstrations are given regarding the ways of studying the freshman subjects. In addition to the group-work, cases presenting special features are given individual attention, for it must be admitted that while certain difficulties are common to all students, there are individual cases that present peculiar phases and these can be served only by personal consultations. These personal consultations are expensive both in time and patience, for it frequently happens that the mental habits of a student must be thoroughly reconstructed, and this

requires much time and attention, but the results well repay the effort. A valuable accessory to such individual supervision over students has been found in the use of psychological tests which have been described by the author in a monograph entitled, "The Scientific Study of the College Student." ¹

But the college is not the most strategic point at which to administer guidance in methods of study. Such training is even more acceptably given in the high school and grades. Here habits of mental application are largely set, and it is of the utmost importance that they be set right, for the sake of the welfare of the individuals and of the institutions of higher education that receive them later. Another reason for incorporating training in methods of study into secondary and elementary schools is that more individuals will be helped, inasmuch as the eliminative process has not yet reached its culmination.

In high schools where systematic supervision of study is a feature, classes are usually conducted in Methods of Study, and it is hoped that this book will meet the demand for a text-book for such classes, the material being well within the reach of high school students. In high schools where instruction in Methods of Study is given as part of a course in elementary psychology, the book should also prove useful, inasmuch as it gives a summary of psychological principles relating to the cognitive processes.

In the grades the book cannot be put into the hands of the pupils, but it should be mastered by the teacher and applied in her supervising and teaching activities. Embodying, as it does, the results of researches in educational psychology, it should prove especially suitable for use in teachers' reading circles where a concise presentation of the facts regarding the psychology of the learning process is desired.

There is another group of students who need training in methods of study. Brain workers in business and industry feel deeply the need of greater mental efficiency and seek eagerly for means to attain it. Their earnestness in this search is evidenced by the success of various systems for the training of memory, will, and other mental traits. Further evidence is found in the efforts of many corporations to maintain schools and classes for the intellectual improvement of their employees. To all such the author offers the work with the hope that it may be useful in directing them toward greater mental efficiency.

In courses in Methods of Study in which the book is used as a class-text, the instructor should lay emphasis not upon memorization of the facts in the book, but upon the application of them in study. He should

¹ Princeton University Press.

expect to see parallel with progress through the book, improvement in the mental ability of the students. Specific problems may well be arranged on the basis of the subjects of the curriculum, and students should be urged to utilize the suggestions immediately. The subjects treated in the book are those which the author has found in his experience with college students to constitute the most frequent sources of difficulty, and under these conditions, the sequence of topics followed in the book has seemed most favorable for presentation. With other groups of students, however, another sequence of topics may be found desirable; if so, the order of topics may be changed. For example, in case the chapter on brain action is found to presuppose more physiological knowledge than that possessed by the students, it may be omitted or may be used merely for reference when enlightenment is desired upon some of the physiological descriptions in later chapters. Likewise, the chapter dealing with intellectual difficulties of college students may be omitted with non-collegiate groups.

The heavy obligation of the author to a number of writers will be apparent to one familiar with the literature of theoretical and educational psychology. No attempt is made to render specific acknowledgments, but special mention should be made of the large draughts made upon the two books by Professor Stiles which treat so helpfully of the bodily relations of the student. These books contain so much good sense and scientific information that they should receive a prominent place among the books recommended to students. Thanks are due to Professor Edgar James Swift and Charles Scribner's Sons for permission to use a figure from "Mind in the Making"; and to J.B. Lippincott Company for adaptation of cuts from Villiger's "Brain and Spinal Cord."

The author gratefully acknowledges helpful suggestions from Professors James R. Angell, Charles H. Judd and C. Judson Herrick, who have read the greater part of the manuscript and have commented upon it to its betterment. The obligation refers, however, not only to the immediate preparation of this work but also to the encouragement which, for several years, the author has received from these scientists, first as student, later as colleague.

THE AUTHOR.

CHICAGO, September 25, 1916.

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1. INTELLECTUAL PROBLEMS OF THE COLLEGE FRESHMAN

In entering upon a college course you are taking a step that may completely revolutionize your life. You are facing new situations vastly different from any you have previously met. They are also of great variety, such as finding a place to eat and sleep, regulating your own finances, inaugurating a new social life, forming new friendships, and developing in body and mind. The problems connected with mental development will engage your chief attention. You are now going to use your mind more actively than ever before and should survey some of the intellectual difficulties before plunging into the fight.

Perhaps the first difficulty you will encounter is the substitution of the lecture for the class recitation to which you were accustomed in high school. This substitution requires that you develop a new technique of learning, for the mental processes involved in an oral recitation are different from those used in listening to a lecture. The lecture system implies that the lecturer has a fund of knowledge about a certain field and has organized this knowledge in a form that is not duplicated in the literature of the subject. The manner of presentation, then, is unique and is the only means of securing the knowledge in just that form. As soon as the words have left the mouth of the lecturer they cease to be accessible to you. Such conditions require a unique mental attitude and unique mental habits. You will be obliged, in the first place, to maintain sustained attention over long periods of time. The situation is not like that in reading, in which a temporary lapse of attention may be remedied by turning back and rereading. In listening to a lecture, you are obliged to catch the words "on the fly." Accordingly you must develop new habits of paying attention. You will also need to develop a new technique for memorizing, especially for memorizing things heard. As a partial aid in this, and also for purposes of organizing material received in lectures, you will need to develop ability to take notes. This is a

process with which you have heretofore had little to do. It is a most important phase of college life, however, and will repay earnest study.

Another characteristic of college study is the vast amount of reading required. Instead of using a single text-book for each course, you may use several. They may cover great historical periods and represent the ideas of many men. In view of the amount of reading assigned, you will also be obliged to learn to read faster. No longer will you have time to dawdle sleepily through the pages of easy texts; you will have to cover perhaps fifty or a hundred pages of knotty reading every day. Accordingly you must learn to handle books expeditiously and to comprehend quickly. In fact, economy must be your watchword throughout. A German lesson in high school may cover thirty or forty lines a day, requiring an hour's preparation. A German assignment in college, however, may cover four or five or a dozen pages, requiring hard work for two or three hours.

You should be warned also that college demands not only a greater quantity but also a higher quality of work. When you were a high school student the world expected only a high school student's accomplishments of you. Now you are a college student, however, and your intellectual responsibilities have increased. The world regards you now as a person of considerable scholastic attainment and expects more of you than before. In academic terms this means that in order to attain a grade of 95 in college you will have to work much harder than you did for that grade in high school, for here you have not only more difficult subject-matter, but also keener competition for the first place. In high school you may have been the brightest student in your class. In college, however, you encounter the brightest students from many schools. If your merits are going to stand out prominently, therefore, you must work much harder. Your work from now on must be of better quality.

Not the least of the perplexities of your life as a college student will arise from the fact that no daily schedule is arranged for you. The only time definitely assigned for your work is the fifteen hours a week, more or less, spent in the class-room. The rest of your schedule must be arranged by yourself. This is a real task and will require care and thought if your work is to be done with greatest economy of time and effort.

This brief survey completes the catalogue of problems of mental development that will vex you most in adjusting your methods of study to college conditions. In order to make this adjustment you will be obliged to form a number of new habits. Indeed, as you become more and more expert as a student, you will see that the whole process resolves itself into one of habit-formation, for while a college education has two phases--the acquisition of facts and the formation of habits--it is the latter which is the more important. Many of the facts that you learn will be forgotten; many will be outlawed by time; but the habits of study you form will be permanent possessions. They will consist of such things as methods of grasping facts, methods of reasoning about facts, and of concentrating attention. In acquiring these habits you must have some material upon which you may concentrate your attention, and it will be supplied by the subjects of the curriculum. You will be asked, for instance, to write innumerable

themes in courses in English composition; not for the purpose of enriching the world's literature, nor for the delectation of your English instructor, but for the sake of helping you to form habits of forceful expression. You will be asked to enter the laboratory and perform numerous experiments, not to discover hitherto unknown facts, but to obtain practice in scientific procedure and to learn how to seek knowledge by yourself. The curriculum and the faculty are the means, but you yourself are the agent in the educational process. No matter how good the curriculum or how renowned the faculty, you cannot be educated without the most vigorous efforts on your part. Banish the thought that you are here to have knowledge "pumped into" you. To acquire an education you must establish and maintain not a passive attitude but an active attitude. When you go to the gymnasium to build up a good physique, the physical director does not tell you to hold yourself limp and passive while he pumps your arms and legs up and down. Rather he urges you to put forth effort, to exert yourself until you are tired. Only by so doing can you develop physical power. This principle holds true of mental development. Learning is not a process of passive "soaking-in." It is a matter of vigorous effort, and the harder you work the more powerful you become. In securing a college education you are your own master.

In the development of physical prowess you are well aware of the importance of doing everything in "good form." In such sports as swimming and hurdling, speed and grace depend primarily upon it. The same principle holds true in the development of the mind. The most serviceable mind is that which accomplishes results in the shortest time and with least waste motion. Take every precaution, therefore, to rid yourself of all superfluous and impeding methods.

Strive for the development of good form in study. Especially is this necessary at the start. Now is the time when you are laying the foundations for your mental achievements in college. Keep a sharp lookout, then, at every point, to see that you build into the foundation only those materials and that workmanship which will support a masterly structure.

READINGS AND EXERCISES

NOTE.--Numbers in parentheses refer to complete citations in Bibliography at end of book.

Readings:

- Fulton (5)
- Lockwood (11)

Exercises:

- Exercise 1. List concrete problems that have newly come to you since your arrival upon the campus.
- Exercise 2. List in order the difficulties that confront you in preparing your daily lessons.

- Exercise 3. Prepare a work schedule similar to that provided by the form in Chart I. Specify the subject with which you will be occupied at each period.
- Exercise 4. Try to devise some way of registering the effectiveness with which you carry out your schedule. Suggestions are contained in the summary: Disposition of (1) as planned; (2) as spent. To divide the number of hours wasted by 24 will give a partial "index of efficiency."

2. NOTE TAKING

Most educated people find occasion, at some time or other, to take notes. Although this is especially true of college students, they have little success, as any college instructor will testify. Students, as a rule, do not realize that there is any skill involved in taking notes. Not until examination time arrives and they try vainly to labor through a maze of scribbling, do they realize that there must be some system in note-taking. A careful examination of note-taking shows that there are rules or principles, which, when followed, have much to do with increasing ability in study.

One criterion that should guide in the preparation of notes is the use to which they will be put. If this is kept in mind, many blunders will be saved. Notes may be used in three ways: as material for directing each day's study, for cramming, and for permanent, professional use. Thus a note-book may be a thing of far-reaching value. Notes you take now as a student may be valuable years hence in professional life. Recognition of this will help you in the preparation of your notes and will determine many times how they should be prepared.

The chief situations in college which require note-taking are lectures, library reading and laboratory work. Accordingly the subject will be considered under these three heads.

LECTURE NOTES.--When taking notes on a lecture, there are two extremes that present themselves, to take exceedingly full notes or to take almost no notes. One can err in either direction. True, on first thought, entire stenographic reports of lectures appear desirable, but second thought will show that they may be dispensed with, not only without loss, but with much gain. The most obvious objection is that too much time would be consumed in transcribing short-hand notes. Another is that much of the material in a lecture is undesirable for permanent possession. The instructor repeats much for the sake of emphasis; he

multiplies illustrations, not important in themselves, but important for the sake of stressing his point. You do not need these illustrations in written form, however, for once the point is made you rarely need to depend upon the illustrations for its retention. A still more cogent objection is that if you occupy your attention with the task of copying the lecture verbatim, you do not have time to think, but become merely an automatic recording machine. Experienced stenographers say that they form the habit of recording so automatically that they fail utterly to comprehend the meaning of what is said. You as a student cannot afford to have your attention so distracted from the meaning of the lecture, therefore reduce your classroom writing to a minimum.

Probably the chief reason why students are so eager to secure full lecture notes is that they fear to trust their memory. Such fears should be put at rest, for your mind will retain facts if you pay close attention and make logical associations during the time of impression. Keep your mind free, then, to work upon the subject-matter of the lecture. Debate mentally with the speaker. Question his statements, comparing them with your own experience or with the results of your study. Ask yourself frequently, "Is that true?" The essential thing is to maintain an attitude of mental activity, and to avoid anything that will reduce this and make you passive. Do not think of yourself as a vat into which the instructor pumps knowledge. Regard yourself rather as an active force, quick to perceive and to comprehend meaning, deliberate in acceptance and firm in retention.

After observing the stress laid, throughout this book, upon the necessity for logical associations, you will readily see that the key-note to note-taking is, Let your notes represent the logical progression of thought in the lecture. Strive above all else to secure the skeleton--the framework upon which the lecture is hung. A lecture is a logical structure, and the form in which it is presented is the outline. This outline, then, is your chief concern. In the case of some lectures it is an easy matter. The lecturer may place the outline in your hands beforehand, may present it on the black-board, or may give it orally. Some lecturers, too, present their material in such clear-cut divisions that the outline is easily followed. Others, however, are very difficult to follow in this regard.

In arranging an outline you will find it wise to adopt some device by which the parts will stand out prominently, and the progression of thought will be indicated with proper subordination of titles. Adopt some system at the beginning of your college course, and use it in all your notes. The system here given may serve as a model, using first the Roman numerals, then capitals, then Arabic numerals:

I. II. A. B. 1. 2. a. b. (1) (2) (a) (b)

In concluding this discussion of lecture notes, you should be urged to make good use of your notes after they are taken. First, glance over them as soon as possible after the lecture. Inasmuch as they will then be fresh in your mind, you will be able to recall almost the entire lecture; you will also be able to supply

missing parts from memory. Some students make it a rule to reduce all class-notes to typewritten form soon after the lecture. This is an excellent practice, but is rather expensive in time. In addition to this after-class review, you should make a second review of your notes as the first step in the preparation of the next day's lesson. This will connect up the lessons with each other and will make the course a unified whole instead of a series of disconnected parts. Too often a course exists in a student's mind as a series of separate discussions and he sees only the horizon of a single day. This condition might be represented by a series of disconnected links:

O O O O O

A summary of each day's lesson, however, preceding the preparation for the next day, forges new links and welds them all together into an unbroken chain:

OOOOOOOOOO

A method that has been found helpful is to use a double-page system of note taking, using the left-hand page for the bare outline, with largest divisions, and the right-hand page for the details. This device makes the note-book readily available for hasty review or for more extended study.

READING NOTES.--The question of full or scanty notes arises in reading notes as in lecture notes. In general, your notes should represent a summary, in your own words, of the author's discussion, not a duplication of it. Students sometimes acquire the habit of reading single sentences at a time, then of writing them down, thinking that by making an exact copy of the book, they are playing safe. This is a pernicious practice; it spoils continuity of thought and application. Furthermore, isolated sentences mean little, and fail grossly to represent the real thought of the author. A better way is to read through an entire paragraph or section, then close the book and reproduce in your own words what you have read. Next, take your summary and compare with the original text to see that you have really grasped the point. This procedure will be beneficial in several ways. It will encourage continuous concentration of attention to an entire argument; it will help you to preserve relative emphasis of parts; it will lead you to regard thought and not words. (You are undoubtedly familiar with the state of mind wherein you find yourself reading merely words and not following the thought.) Lastly, material studied in this way is remembered longer than material read scappily. In short, such a method of reading makes not only for good memory, but for good mental habits of all kinds. In all your reading, hold to the conception of yourself as a thinker, not a sponge. Remember, you do not need to accept unqualifiedly everything you read. A worthy ideal for every student to follow is expressed in the motto carved on the wall of the great reading-room of the Harper Memorial Library at The University of Chicago: "Read not to contra-

dict, nor to believe, but to weigh and consider." Ibsen bluntly states the same thought:

"Don't read to swallow; read to choose, for 'Tis but to see what one has use for."

Ask yourself, when beginning a printed discussion, What am I looking for? What is the author going to talk about? Often this will be indicated in topical headings. Keep it in the background of your mind while reading, and search for the answer. Then, when you have read the necessary portion, close the book and summarize, to see if the author furnished what you sought. In short, always read for a purpose. Formulate problems and seek their solutions. In this way will there be direction in your reading and your thought.

This discussion of reading notes has turned into an essay on "How to Read," and you must be convinced by this time that there is much to learn in this respect, so much that we may profitably spend more time in discussing it.

Every book you take up should be opened with some preliminary ceremony. This does not refer to the physical operation of opening a new book, but to the mental operation. In general, take the following steps:

1. Observe the title. See exactly what field the book attempts to cover.
2. Observe the author's name. If you are to use his book frequently, discover his position in the field. Remember, you are going to accept him as authority, and you should know his status. You may be told this on the title-page, or you may have to consult Who's Who, or the biographical dictionary.
3. Glance over the preface. Under some circumstances you should read it carefully. If you are going to refer to the book very often, make friends with the author; let him introduce himself to you; this he will do in the preface. Observe the date of publication, also, in order to get an idea as to the recency of the material.
4. Glance over the table of contents. If you are very familiar with the field, and the table of contents is outlined in detail, you might advantageously study it and dispense with reading the book. On the other hand, if you are going to consult the book only briefly, you might find it necessary to study the table of contents in order to see the relation of the part you read to the entire work.
5. Use the index intelligently; it may save you much time.

You will have much to do throughout your college course with the making of bibliographies, that is, with the compilation of lists of books bearing upon special topics. You may have bibliographies given you in some of your courses, or you may be asked to compile your own. Under all circumstances, prepare them with the greatest care. Be scrupulous in giving references. There is a standard form for referring to books and periodicals, as follows:

- C.R. Henderson, *Industrial Insurance* (2d ed.; Chicago: The University of Chicago Press, 1912), p. 321.

- S.I. Curtis, "The Place of Sacrifice," *Biblical World*, Vol. XXI (1902), p. 248 ff.

LABORATORY NOTES.--The form for laboratory notes varies with the science and is usually prescribed by the instructor. Reports of experiments are usually written up in the order: Object, Apparatus, Method, Results, Conclusions. When detailed instructions are given by the instructor, follow them accurately. Pay special attention to neatness. Instructors say that the greatest fault with laboratory note-books is lack of neatness. This reacts upon the instructor, causing him much trouble in correcting the note-book. The resulting annoyance frequently prejudices him, against his will, against the student. It is safe to assert that you will materially increase your chances of a good grade in a laboratory course by the preparation of a neat note-book.

The key-note of the twentieth century is economy, the tendency in all lines being toward the elimination of waste. College students should adopt this aim in the regulation of their study affairs, and there is much opportunity for applying it in note-taking. So far, the discussion has had to do with the content of the note-book, but its form is equally important. Much may be done by utilization of mechanical devices to save time and energy.

First, write in ink. Pencil marks blur badly and become illegible in a few months. Remember, you may be using the notebook twenty years hence, therefore make it durable.

Second, write plainly. This injunction ought to be superfluous, for common sense tells us that writing which is illegible cannot be read even by the writer, once it has "grown cold." Third, take care in forming sentences. Do not make your notes consist simply of separate, scrappy jottings. True, it is difficult, under stress, to form complete sentences. The great temptation is to jot down a word here and there and trust to luck or an indulgent memory to supply the context at some later time. A little experience, however, will quickly demonstrate the futility of such hopes; therefore strive to form sensible phrases, and to make the parts of the outline cohere. Apply the principles of English composition to the preparation of your note-book.

A fourth question concerns size and shape of the note-book. These features depend partly upon the nature of the course and partly upon individual taste. It is often convenient and practicable to keep the notes for all courses in a single note-book. Men find it advantageous to use a small note-book of a size that can be carried in the coat pocket and studied at odd moments.

A fifth question of a mechanical nature is, which is preferable, bound or loose-leaf note-books? Generally the latter will be found more desirable. Leaves are easily inserted and the sections are easily filed on completion of a course.

It goes without saying that the manner in which notes, are to be taken will be determined by many factors, such as the nature of individual courses, the wishes of instructors, personal tastes and habits. Nevertheless, there are certain principles and practices which are adaptable to nearly all conditions, and it is these that we have discussed. Remember, note-taking is one of the habits you

are to form in college. See that the habit is started rightly. Adopt a good plan at the start and adhere to it. You may be encouraged, too, with the thought that facility in note-taking will come with practice. Note-taking is an art and as you practise you will develop skill.

We have noted some of the most obvious and immediate benefits derived from well-prepared notes, consisting of economy of time, ease of review, ease of permanent retention. There are other benefits, however, which, though less obvious, are of far greater importance. These are the permanent effects upon the mind. Habits of correct thinking are the chief result of correct note-taking. As you develop in this particular ability, you will find corresponding improvement in your ability to comprehend and assimilate ideas, to retain and reproduce facts, and to reason with thoroughness and independence.

READINGS AND EXERCISES

Readings:

- Adams (1) Chapter VIII.
- Dearborn (2) Chapter II.
- Kerfoot (10)
- Seward (17)

Exercises:

- Exercise 1. Contrast the taking of notes from reading and from lectures.
- Exercise 2. Make an outline of this chapter.
- Exercise 3. Make an outline of some lecture.

3. BRAIN ACTION DURING STUDY

Though most people understand more or less vaguely that the brain acts in some way during study, exact knowledge of the nature of this action is not general. As you will be greatly assisted in understanding mental processes by such knowledge, we shall briefly examine the brain and its connections. It will be manifestly impossible to inquire into its nature very minutely, but by means of a description you will be able to secure some conception of it and thus will be able better to control the mental processes which it underlies.

To the naked eye the brain is a large jelly-like mass enclosed in a bony covering, about one-fourth of an inch thick, called the skull. Inside the skull it is protected by a thick membrane. At its base emerges the spinal cord, a long strand of nerve fibers extending down the spine. For most of its length, the cord is about as large around as your little finger, but it tapers at the lower end. From it at right angles throughout its length branch out thirty-one pairs of fibrous nerves which radiate to all parts of the body. The brain and spinal cord, with all its ramifications, are known as the nervous system. You see now that, though we started with the statement that the mind is intimately connected with the brain, we must now enlarge our statement and say it is connected with the entire nervous system. It is therefore to the nervous system that we must turn our attention.

Although to the naked eye the nervous system is apparently made up of a number of different kinds of material, still we see, when we turn our microscopes upon it, that its parts are structurally the same. Reduced to lowest terms, the nervous system is found to be composed of minute units of structure called nerve-cells or neurons. Each of these looks like a string frayed out at both ends, with a bulge somewhere along its length. The nervous system is made up of millions of these little cells packed together in various combinations and distri-

buted throughout the body. Some of the neurons are as long as three feet; others measure but a fraction of an inch in length.

We do not know exactly how the mind, that part of us which feels, reasons and wills, is connected with this mass of cells called the nervous system. We do know, however, that every time anything occurs in the mind, there is a change in some part of the nervous system. Applying this fact to study, it is obvious that when you are performing any of the operations of study, memorizing foreign vocabularies, making arithmetical calculations, reasoning out problems in geometry, you are making changes in your nervous system. The question before us, then, is, What is the nature of these changes?

According to present knowledge, the action of the nervous system is best conceived as a form of chemical change that spreads among the nerve-cells. We call this commotion the nervous current. It is very rapid, moving faster than one hundred feet a second, and runs along the cells in much the same way as a "spark runs along a train of gunpowder." It is important to note that neurons never act singly; they always act in groups, the nervous current passing from neuron to neuron. It is thought that the most important changes in the nervous system do not occur within the individual neurons, but at the points where they join with each other. This point of connection is called the synapse and although we do not understand its exact nature, it may well be pictured as a valve that governs the passage of the nervous current from neuron to neuron. At time of birth, most of the valves are closed. Only a few are open, mainly those connected with the vegetative processes such as breathing and digestion. But as the individual is played upon by the objects of the environment, the valves open to the passage of the nervous current. With increased use they become more and more permeable, and thus learning is the process of making easier the passage of the nervous current from one neuron to another.

We shall secure further light upon the action of the nervous system if we examine some of the properties belonging to nerve-cells. The first one is impressibility. Nerve-cells are very sensitive to impressions from the outside. If you have ever had the dentist touch an exposed nerve, you know how extreme this sensitivity is. Naturally such a property is very important in education, for had we not the power to receive impressions from the outside world we should not be able to acquire knowledge. We should not even be able to perceive danger and remove ourselves from harm. "If we compare a man's body to a building, calling the steel frame-work his skeleton and the furnace and power station his digestive organs and lungs, the nervous system would include, with other things, the thermometers, heat regulators, electric buttons, door-bells, valve-openers,--the parts of the building, in short, which are specifically designed to respond to influences of the environment." The second property of nerve-cells which is important in study is conductivity. As soon as a neuron is stimulated at one end, it communicates its excitement, by means of the nervous current, to the next neuron or to neighboring neurons. Just as an electric current might pass along one wire, thence to another, and along it to a third, so the nervous current passes from neuron to neuron. As might be expected, the two functions of

impressibility and conductivity are aided by such an arrangement of the nerve-cells that the nervous current may pass over definitely laid pathways. These systems of pathways will be described in a later paragraph.

The third property of nerve-cells which is important in study is modifiability. That is, impressions made upon the nerve-cells are retained. Most living tissue is modifiable to some extent. The features of the face are modifiable, and if one habitually assumes a peevish expression, it becomes, after a time, permanently fixed. The nervous system, however, possesses the power of modifiability to a marked degree, even a single impression sufficing to make striking modification. This is very important in study, being the basis for the retentive powers of the mind.

Having examined the action of the nervous system in its simplicity, we have now to examine the ways in which the parts of the nervous system are combined. We shall be helped if we keep to the conception of it as an aggregation of systems or groups of pathways. Some of these we shall attempt to trace out. Beginning with those at the outermost parts of the body, we find them located in the sense-organs, not only within the traditional five, but also within the muscles, tendons, joints, and internal organs of the body such as the heart, and digestive organs. In all these places we find ends of neurons which converge at the spinal cord and travel to the brain. They are called sensory neurons and their function is to carry messages inward to the brain. Thus, the brain represents, in great part, a central receiving station for impressions from the outside world. The nerve-cells carrying messages from the various parts of the body terminate in particular areas. Thus an area in the back part of the brain receives messages from the eyes; another area near the top of the brain receives messages from the skin. These areas are quite clearly marked out and may be studied in detail by means of the accompanying diagram.

There is another large group of nerve-cells which, when traced out, are found to have one terminal in the brain and the other in the muscles throughout the body. The area in the brain, where these neurons emerge, is near the top of the brain in the area marked Motor on the diagram. From here the fibers travel down through the spinal cord and out to the muscles. The nerve-cells in this group are called motor neurons and their function is to carry messages from the brain out to the muscles, for a muscle ordinarily does not act without a nervous current to set it off.

So far we have seen that the brain has the two functions of receiving impressions from the sense-organs and of sending out orders to the muscles. There is a further mechanism that must now be described. When messages are received in the sensory areas, it is necessary that there be some means within the brain of transmitting them over to the motor area so that they may be acted upon. Such an arrangement is provided by another group of nerve-cells in the brain, having as their function the transmission of the nervous current from one area to another. They are called association neurons and transmit the nervous current from sensory areas to motor areas or from one sensory area to another. For example, suppose you see a brick falling from above and you dodge quickly back.