GENERAL PSYCHOLOGY

for

PROFESSIONAL STUDENTS

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PREFACE

This book has been written to fill the specific need for a special text for professional students. Many, if not all, of the available texts in general psychology have been written for students in arts, literature, or science. These texts too frequently have emphasized some particular point of view, have stressed theoretical discussions rather than practical applications, and have limited their illustrations too often to those having only an academic appeal. This book has been written by men who hold different points of view in psychology, but who have harmonized these views in the materials presented here. While it is a text in general psychology, treating the topics in general psychology, the attempt has been made to introduce as much objective material and as little theoretical material as possible. Finally, the illustrations have been selected, so far as practicable, from the fields of industry and the professions.

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CHAPTER I

NATURE AND PURPOSE OF PSYCHOLOGY

I. Psychology and Life Intimately Related

As civilization advances, man must adjust himself more and more to those around him. He must know more psychology than his forefathers did. In general, the higher order of vocations requires a wider knowledge of human nature than the lower order. The professional man — the lawyer, the physician, the teacher, the executive, the salesman, and the advertiser — will find psychology especially valuable.

As civilization becomes more complex, the adjustments of any particular individual to the society in which he lives become more and more dependent upon his understanding of human nature. In a primitive environment man is more or less self-sufficient, but in a civilized community his activities become highly specialized; he does work which contributes to the welfare of others and his very life depends upon the work that others are doing. Each man is a highly specialized part of an intricate organization and he must recognize more and more that his very existence depends upon the degree of success he achieves in fulfilling adequately his part of the program of civilization.

In some of the more humble occupations of life, an understanding of people is not so important as it is in others. One may have a menial, routine task for which he is paid a wage with which he is able to buy the things he needs. He can exist with but few social adjustments and even these few may be very faulty. But as one advances in the occupational scale, especially when one engages in a profession, the interdependence of human beings becomes more striking. To-day every professional man feels the need of at least some practical knowledge of psychology. We shall now consider the principal methods by which such a knowledge may be obtained.

Methods for Acquiring a Knowledge of Psychology. A knowledge of psychology may be gained by several methods, not all of them equally good.

1. *From experience.* Some professional men believe that a knowledge of psychology must be acquired by a hit-and-miss method through actual contact with people. Advocates of this theory advise young men to enter active professional life and learn by experience how other men think and act. Psychology may be studied in this manner, but it is an extremely costly method. It would be just as reasonable to urge that a child learn to avoid speeding automobiles by being left to run about in a busy section of the city. The majority of children would learn by this method, just as chickens, dogs, and cats learn to avoid being run over, but a great number would be killed in the process. Young men and women entering a professional career should be equipped with a knowledge of human behavior if they are to be successful in their dealings with others.

2. *By studying theories.* Another group of persons, composed largely of academic psychologists, states that the only way to learn psychology is to study all the intricate details of psychological theory, avoiding all reference to any practical application of the theory until a thorough theoretical groundwork has been laid. Such a procedure too often eliminates all interest in the subject, and many students are repelled, instead of becoming more fascinated, by the subject as they proceed.

Certainly no subject of study is more fascinating than that of human nature, and surely scientific approach to a subject is not in the least incompatible with interest.

3. *By emphasis upon the spectacular.* Other writers, appealing to the spectacular, have produced various combinations of superstition and nonsense under the guise of psychology. In such books one can find fables, folklore, fairy tales, politics, and religion. All of these types of literature have value, but why call them psychology?

4. *By interest of application combined with scientific accuracy.* The authors of this book believe that, without detracting from the scientific accuracy of the facts, on the one hand, or without making unwarranted generalizations, on the other, sound psychological theory can be presented in such a manner that the professional student can see how it may be utilized in his particular field. Let us illustrate from another field the principle we have in mind. One of the authors, some years ago, was studying physics in a high school. In the laboratory he constructed a microphone by placing in loose contact two pieces of carbon. When the microphone was placed in an electrical circuit, any vibration changed the resistance between the carbon contacts so that this change could be observed on a voltmeter or detected in a telephone receiver. Neither the instructor nor the textbook mentioned the application of this principle. Some years later, the author discovered that all telephone transmitters are microphones. It would not have detracted from the scientific accuracy of this laboratory experiment or decreased the students' interest in it if the practical applications had been explained.

This is the principle which the authors of this book plan to follow throughout. They will adhere rigidly to scientific accuracy in their presentation, but will attempt to indicate, wherever possible, how the principles apply to conduct in one's professional contacts.

Value of Psychology for Specific Professions. Too often the young professional student finds his time so occupied with acquiring the materials directly essential to his profession that he has no time for the study of psychology. It is only when he gets into actual work that he becomes keenly aware of the need for this knowledge. Then his frantic search for some material that will help him to understand people yields but a scanty and superficial grasp of psychological principles. It would be more to his advantage to get the groundwork of psychology early in his training so that a knowledge of human behavior would become definitely related to his professional training. A survey of some of the situations in different professions where psychology is directly applicable will make this fact clearly apparent.

1. *The lawyer needs psychology.* Laws are formulated in a direct attempt to regulate the behavior of men in social situations. If the laws are formulated to fit human needs, they will be obeyed by normal persons and will stand the test of time. Those which go counter to psychological principles tend toward eventual failure, as the history of law has amply demonstrated. In the application of laws, knowledge of human behavior is even more essential. This is especially true in the field of criminology. To cope with crime, it is not enough to ascertain that a crime was committed; we must know something of the psychology of the criminal; we must learn why he committed the crime and discern the motivation behind the act. If a man steals a pocketbook, it may be more important to know why he did it than to know how much money was in the pocketbook. Only in this way can we arrive at a judgment of the enormity of the offense. The old conception of punishment as a means of revenge is giving way to the new conception of punishment as a means of stopping criminality.

2. *The physician needs psychology.* Mental health and physical health go hand in hand, as every practitioner of medi-

cine knows. The offices of medical men are crowded with persons whose bodies are perfect but whose minds are sick. The old method of dismissing such patients with a shrug and the assurance that there is nothing wrong with them, that " it is all in their imaginations," is giving way to an adequate understanding by every practitioner of the nature of imaginary ills. Even when there is a genuine physical disease, the mental life of the patient has a direct influence on the course of that disorder. Digestive disturbances may be precipitated by emotional crises. A depression may so lower the bodily tone of a person that he becomes susceptible to the ravages of disease in a way that would not be possible were he happy. The development of occupational therapy, whereby patients are kept busy and contented, is an acknowledgment on the part of the medical profession that contentment is a healing agent. A practitioner who knows enough of human behavior to try to convince his patient that he is doing something for him is sure to be more successful than the one who gruffly dispenses drugs without considering that he is dealing with a human being. A medical student is much better prepared for his profession by having a knowledge of psychology.

3. *Education is applied psychology.* The modern educator recognizes that his profession is essentially an application of psychology. We no longer arrange the subject matter of a study without a consideration of the learning process. The educator needs to be very familiar with the laws of learning. He must guide his student so that the material learned will become a part of the student's life and will so stimulate him that after he leaves the educational institution he will continue to use not only the material, but also the methods, he was taught in school. Education has come to be focussed upon the learner rather than upon the material to be learned. The result has been a continual raising of academic standards, as is evidenced by the fact that we are now teaching high-school pupils many

subjects which some years ago were restricted to courses o. college grade.

4. *Psychology is valuable in industry.* Modern industry is replete with psychological applications. Along with the development of mass production and mechanical manufacturing devices goes the complex problem of training men to guide the machinery of production. Under the old régime a disgruntled laborer whose work was of the wholly unskilled type might have little direct influence upon the total efficiency of a manufacturing establishment, but a careless or a sullen worker to-day can upset a whole establishment. Great stress is now placed on employee-employer relationships.

Another consequence of modern industrial organization is the distance between employer and employee. Under the old method of household production there was a close relationship between employer and employee, the employer usually working along with his helpers. In the modern large industry there is practically no chance for any such acquaintanceship. Therefore the problems of hiring, placement, promotion, and discharging must be handled by others instead of by the employer himself. These are all problems of personal relations, and hence are largely psychological.

5. *Selling is a problem in psychology.* Most buying and selling is dependent upon the personal relationship of the salesman to the prospective purchaser. The shrewd salesman carefully analyzes the methods of selling. He finds that his success depends primarily upon three things: (1) his knowledge of the product to be sold, (2) his knowledge and control of himself as the person who is to modify the conduct of the customer, and (3) his knowledge of the mental processes of the customer and the steps by which the latter arrives at a decision to buy or not to buy.

The buyer, to be shrewd, should also know the laws of p[illegible]chology. He should know how to interpret the behavior of the salesman and be able to analyze the influences the salesman is bringing to bear. Is he being influenced by the personal charm of the salesman, by a play upon his emotional attitudes, by emphasis upon some silly detail about the product, by fallacious arguments which have the appearance of rationality, or is he being made familiar with a product and learning how this product will minister to his wants?

6. *Psychology is used in advertising.* A knowledge of human nature is especially important in advertising. Advertisers are not content to know that a certain advertisement has produced results; they want to know the reason for its success so that they may utilize the knowledge in forthcoming advertising campaigns. The business man probably knows as keenly as anybody the cash value of a knowledge of human psychology.

II. Necessary Assumptions

The reader is asked to accept tentatively, as a working foundation, the truth of four statements. These are: (1) Human conduct operates according to definite laws. (2) Adherence to rigid scientific procedure will enable us to discover these laws. (3) The operation of these laws in life will probably be very complex. (4) Great individual differences will be found in all phases of human life.

An open-minded attitude on the part of the student precludes the possibility of opinions becoming fixed before he has had an opportunity to test them. But he will find it advisable to begin with a very few tentative hypotheses which he agrees to accept as true, at least until facts have demonstrated that they are false. These hypotheses are so fundamental that it would be useless to proceed unless we assumed their truth. Although they could be proved, they are so obvious that they are axiomatic. If we accept them, they will serve as a good foundation upon which to build a psychological superstructure.

Human Conduct Is Orderly. The first principle which need to accept is that human conduct is orderly. If there v no laws of human conduct, we could expect only endless c fusion. For centuries it was believed that each individual a law unto himself, that each man could do just as he pleas and that any attempt to predict human conduct was tota futile. To-day it is generally accepted that mental life do follow laws, and the study of psychology includes an attempt to formulate these laws scientifically.

Mental Life Is Subject to Scientific Study. Laws in branches of knowledge other than psychology have been discovered by following a definite method which has come to be known as the scientific method. If we are to define the laws of mental life, the same method must be used. While we may be convinced in our own thinking that a certain principle is sound, we should refrain from assuming the correctness of such a principle unless it can be demonstrated by scientific method. Science does not deny things which it has not proved; it simply maintains an attitude of skepticism until such a demonstration is forthcoming. The elements of such scientific procedure we shall outline presently.

Mental Life Is Complex. To state that mental life is orderly does not imply that it is simple. In fact it is so complex that it is baffling at many points and, even though we may discover laws which operate, we must bear in mind that probably no single act is determined by a single cause, but by a complex group of causes. This fact makes it quite unlikely that we shall ever come to such a complete understanding of all the laws of mental life that we can predict exactly what will happen in the life of any single individual. But as we come to a more precise appreciation of the major laws of human conduct, we shall be able to predict with some degree of assurance that behavior will fall within a certain range. For example, psychologists have found that if a person lifts two blocks of equal weight which are apparently made of the same material but one of which is much larger than the other, the smaller one will be judged to be heavier than the larger one. Thus, we have a high degree of expectancy that a person lifting these two weights will tell us that the smaller one is heavier. But we may encounter a stubborn person who says that the larger one is heavier, or another person who knows about the illusion and states that they both weigh the same, or still another person who may be suspicious and refuse to answer at all. Hence, we cannot be absolutely certain what the reply will be unless we know all the factors operative in the response of a particular individual. But such a condition does not vitiate the principle that laws are operative; it is merely an acknowledgment of the complexity of life.

Individuals Differ. In what is ordinarily called general psychology, the aim is to discover principles of conduct which may be expected to operate with a fair degree of uniformity in all individuals. The knowledge of such laws helps us in our prediction of what individuals will do under various conditions. The more accurately such laws can be stated, the more valuable our psychology becomes. For example, we know that a person cannot perceive and remember readily more than about seven digits. If we had automobile license numbers of greater length, such as 8374928384, they would be useless. Such a number could not be used for identification unless one had time to copy it. Even such a number as 837492 is hard to grasp. Another principle helps here. If numbers are grouped, they are perceived more readily and remembered better. Consequently, if we group the number by using a hyphen, as 837-492, we have made it a symbol which becomes much more serviceable. Such general principles are most valuable.

However, a fact which must be considered is that individuals differ so widely in their mental constitutions that the laws which we discover will operate in different combinations in different persons. Although this makes our problem more difficult, at the same time, it furnishes one of the great fascinations of human psychology. After we have learned all we can, we must reinterpret our laws in the light of every new situation we encounter. There is a tendency, after we have observed one person, to assume that another person who resembles him in one respect must also resemble him in other respects. Such an assumption will lead only to confusion. All laws need specific interpretations in concrete situations, but this is especially true in psychology.

The four assumptions discussed in this section are the guiding principles behind modern psychology. By remembering them, we may keep the aim of psychological study before us without running into the danger of making unwarranted assumptions from too few data.

III. Psychology a Branch of Science

Every branch of science must conform to the methods of investigation which science has found to be valid. In addition each branch must develop specific procedures, called techniques, which it alone uses. These techniques cannot violate the general principles of scientific procedure; they are merely elaborations of it. In this section we shall outline the general principles of scientific method, and then indicate the specific techniques which psychology uses.

Since the beginning of history men have tried to discover the laws which control the universe. Some men have guessed at them, some have stumbled upon them; but much of the knowledge we possess has come from rigid investigations. Of the theories that developed from the work, study, guesses, and good fortune of our forefathers only those have stood the test of time which can be verified by those rigid procedures which we call scientific method. What is meant by the scientific method?

Essential Steps in Scientific Procedure. Psychology, the youngest of the sciences, should be just as rigid in conforming to the rules of scientific method as any of the older sciences. While each of the following steps is essential to scientific procedure, we should bear in mind that not in every investigation are the steps adhered to in the exact sequence in which they are here stated; but the logical outline presented will serve to get the method of science clearly before us.

1. *Awareness that a problem exists.* Before there can be any scientific work, there must be at least a vague realization that there is a problem to be solved. In some instances it may be merely a dissatisfaction with things as they exist; in others there may be an acute problem calling for solution. For example, if people are dying because of the epidemic of an unknown disease, everyone is aware that physicians are confronted with a problem for scientific investigation. If sales are falling off, the business executive is confronted with a problem for study. In short, dissatisfaction with things as they exist, or as they are explained, is the stimulus for scientific study. To such dissatisfaction one might react by fear, as our superstitious forefathers did; by worry, as one may when the solution looks hopeless; by resignation, as the martyr does; or by some other attitude. The only sane method of meeting a difficulty is to attempt to discover the laws behind the situation. This attempt will lead directly to the succeeding steps in scientific procedure.

2. *The accumulation of data.* All scientific investigations involve the collection of data bearing on the question in hand. Great care must be exercised to insure accurate data. For this purpose instruments of precision are used wherever it is possible to do so. We measure, weigh, count, and otherwise augment crude observation. The scientist is not content with the statement that a loud sound was produced; he employs instruments of precision in order that sounds of the same intensity,

quality, and duration can be used by other investigators to check his findings. He is not content with such qualitative adjectives as *short, long, red,* or *heavy.* He measures in feet and inches or on some other scale; he locates color on the spectrum or states its components in accurate terms; he denotes the specific gravity of an object or otherwise compares it with some standard.

The accumulation of data, no matter how accurately it may be done, does not in itself constitute scientific method. A person might very painstakingly measure the length of every blade of grass on a lawn, but of what value would that be? To be sure, such data might conceivably be used, but usually there is some specific and practical objective for the accumulation of data. One accomplishes more if he has some particular question he is desirous of answering and collects his data in fields related to that query. The danger in this procedure is that the question may bias one in the accumulation of his facts. He may seek those facts which will answer his question the way he would like to have it answered. One has to select his data, but he should do so impartially.

3. *Organization of data.* As facts are gathered, they are found to be related to each other in certain ways. The function of the scientist is to classify these facts as they come to hand. Science is in large part a study of relationships, which become apparent as the data are sifted and organized logically, according to sequence, similarity, and the like.

Here again one must be cautious. The classifications must be regarded as tentative, to be shifted, if necessary, as new materials are added. For example, failure to observe this caution has led to the fallacy that succession indicates a causal relationship. One might collect instances where thinking of an absent person was followed by the appearance of that person and, from these instances, be led to believe that the thinking was a premonition, a mysterious message from the person, or that the thinking influenced the person's conduct and caused him to appear.

4. *The formulation of theories.* With facts gathered and organized, explanatory theories naturally present themselves. One begins to speculate as to the meaning of what he has found. Such speculation is a legitimate part of science, but it is not an end in itself. We have already intimated that the collection of data and the organization of those data are directed by the speculative hypotheses of the investigator. Without some speculation our research would often be pointless. But the scientist must keep clearly in mind which part of his findings is the result of direct evidence and which part is a hypothetical interpretation of that evidence. The shrewd scientist is continually formulating theories, but he never regards these theories as proved until they have been tested by experiment.

5. *Experiment.* The man who takes his speculations too seriously finds no real need of experimental corroboration. It is when we question our hypotheses that we sense the need of some sort of controlled observation to determine the truth or falsity of our reasoning. For example, most persons are convinced that noises are harmful to the human organism. Such a belief is based on more or less scattered observations. Individuals testify that when they are subjected to noises — for example, when they take a trip to the shopping center of a large city on a noisy elevated or subway train — they are completely exhausted. One might accumulate a vast quantity of such testimonial material, but can one be sure from such accumulated evidence that noises are detrimental? What can be done to determine the answer to this problem? The first flaw that the scientific man observes in this evidence is that a trip to the shopping center means not only subjection to noises, but a certain amount of jolting, the strain of shopping, eating in unaccustomed places and perhaps at unusual hours, the strain of talking to persons, an unusual amount of walking and standing,

and various other conditions. Is the fatigue at the end of the day the result of all of these or more particularly of one factor? The only way to answer this question is to keep all factors constant or inoperative except one, and to determine the influence of this one factor. If we are concerned with noise, we must subject ourselves to noise without the addition of the other elements that enter into a noisy shopping day. This is the essence of experiment — to permit only one factor to operate at a time and to observe with careful checks and instruments of precision the results of this one factor.

6. *Prediction.* The final test of the validity of a scientific finding is predictability. If the astronomer, through the application of his laws, predicts the coming of Halley's comet at a certain time and in a certain place, the coming of the comet at that time and place evidences the correctness of his laws, as well as his applications of them to this particular situation. The predictions that we are able to make in psychology may not be absolute or unvarying as they are in some other sciences, but this is the goal for which all sciences strive. If a child touches a hot stove, we can predict that he will manifest some hesitation about touching it on a future occasion. If we direct a bright light into the eye of a person, we can predict with a fair degree of certainty that the pupil will contract. In some instances, the pupil will not contract, a fact which indicates an unusual condition in that individual, probably the result of a disease which affects that particular reaction. If we made a thorough study of such a person's eye, we could predict just how much his pupil would contract with a light of a certain intensity applied for a certain length of time.

Degrees of Scientific Certainty. While the goal of science is such complete certainty, based on experimental evidence, that absolute predictability is possible, the findings in any specific field vary in their approach to this goal, so that we have degrees of validity ranging all the way from sheer guesses to absolute laws. The student needs to keep this fact before him and to learn to evaluate the various facts that are displayed before him. Because a particular finding has not been fully substantiated, it should not necessarily be rejected, but it should be valued for what it is — a hypothesis which may or may not be substantiated by further research. To apply to any statement the qualifying term *scientific* does not mean that the statement should be accepted; it merely means that scientific methods have been used in its formulation. The degree to which it is to be accepted depends upon the extent to which the scientific method has been applied. With this clearly understood, the term *scientific* ceases to be a fetish.

Certain principles may help us to evaluate the different hypotheses which we encounter. These principles, based largely upon the way in which the hypothesis was reached, are numerous, but we shall consider a few which may be used as guides in an attempt at evaluation.

1. *Theories substantiated by experiment are the most valid.* When a theory has stood the test of experiment — when, that is, it has been tried out under carefully controlled conditions, with all possible variables either held constant or eliminated except the one in question — the student can place great confidence in the results. To be sure, some experiments may be faulty and one needs to evaluate very critically the procedure followed, but, assuming that the experiment has been conducted carefully, one can place great reliance upon the theories which have stood this test. Before any theory is accepted, we have a right to demand that it be submitted to this test. For example, we may be told that at a spiritualistic seance the voices of the departed were heard. Unless such voices can be heard under laboratory conditions, where all chances for deception have been eliminated, all opportunity for extraneous sounds that might be interpreted as voices removed, and unless the conditions of experiment are such that it can be performed

with success by anyone who follows directions, one is justified in being skeptical.

2. *Theories based on analogy are often unreliable.* An analogy provides a forceful means of illustrating a point clearly, but it has no place in the realm of scientific evidence. Analogies stimulate the imagination and a hypothesis so derived may prove to be sound, but there is an equal chance that it may prove to be unsound. For example, we may compare the mind to a *tabula rasa,* a smooth waxy plate upon which the various experiences of life leave their mark, but such an analogy does not prove that every experience does leave an ineradicable mark upon the mind. Experience may leave such traces, but the analogy does not help to substantiate it. Other evidence is needed. We may sing, " But the bird with a broken pinion never soars so high again," but this does not prove that an act once committed can never be compensated for. The layman is very likely to take a forceful analogy as a very striking argument, whereas it is the weakest possible argument.

3. *Anecdotes may distort perspective.* Most sciences go through what might be called an anecdotal stage, a period in which most of the data consist of stories collected to illustrate supposed principles. A great deal of so-called psychology is still of this order. A business man will tell how he influenced another to take part in some transaction, concluding his story with the statement that this proves that men may be influenced by the methods he used. He may be right, but his story does not prove it. Such stories may serve to formulate hypotheses and may stimulate research, but the student of human nature will find himself sadly astray if he places any confidence in anecdotes as such. If you wish to convince an audience of a point, you may be able to do it much better by telling an illustrative story than by citing great quantities of evidence, but this simply indicates the credulity of your audience and not the soundness of the story as a piece of scientific evidence. A

story may emphasize unimportant details, it may omit essential elements, or it may stress relationships between parts in such a manner as wholly to mislead the hearer. Although a story will stimulate interest in a subject and clarify an issue, its value as scientific evidence is extremely limited.

4. *Sweeping generalizations are dangerous.* Another handicap to scientific thinking is the tendency to make generalizations on the basis of meager facts. It is so easy to make dogmatic and unwarranted statements that one may easily overlook the dangers that lurk in them. An executive who finds a man with a gold tooth to be incompetent decides never to hire men with gold teeth. If this executive happens to be successful in business, his decision is likely to be accepted as authoritative by the unthinking or uninformed. As a matter of fact, success usually depends upon one's willingness to search for evidence in support of his theories and to abandon his theories if the evidence indicates that they are wrong. Generalizations, then, are theories that should be held only tentatively while one continues to gather more data and perform further experimentation.

The point to be stressed in this discussion is that theories may be derived by means of analogies, anecdotes, generalizations, or mere chance, but the conclusions so reached are merely speculative. Theories are essential to science, but they must be regarded only as ways of thinking and not as types of evidence. As we have indicated previously, the ultimate test of any theory — the test which it must pass before it deserves the rank of a law — is the test of prediction.

Specific Techniques of Psychology. While every science, regardless of its subject matter, must adhere to the scientific method which we have outlined, each science develops its own peculiar techniques. These techniques are determined largely by the nature of the materials to be studied and the difficulties of approach that each one presents. The development of techniques for the scientific study of psychology has been especially difficult because of the intricacy of human nature.

The techniques which psychology has developed are, at best, imperfect, but, even with their limitations, they have yielded much of value. At first psychology borrowed from the techniques of other sciences. Biology, embryology, physiology, anatomy, and neurology have all contributed their share. While help may be secured from patterning after other sciences, such a procedure brings with it some limitations, and no doubt psychology has been somewhat hampered by following too strictly the techniques of other sciences.

The study of the sense organs in psychology has, for the most part, been taken directly from physiology. Our knowledge of the hereditary mechanisms of the human being have been borrowed from genetics. Our theories of the modifications of the nervous system have been gathered largely from neurology. Our study of the human organism as a reacting mechanism has been dependent upon the methods of physiology. But in addition to these borrowed techniques, psychology has developed more or less independently four techniques of its own, which we shall now consider in some detail.

1. *The introspective technique.* The essential nature of introspection is the observation of one's own mental processes. Such a procedure is not so easy as it might appear. Mental activity is never very simple and to observe its complex activity at any one time and report accurately upon it requires considerable skill. In ordinary life we are accustomed to ignore many experiences and to emphasize others. The person who gives a true introspective report must check such tendencies and give an accurate account of every phase of mental activity. As an aid to introspection, the individual is usually placed in a situation where the outside conditions are carefully controlled and are simplified as much as possible, but even in such circumstances, his introspective observations must be repeated

a great number of times before they can become acceptable as scientific data.

Introspection has been most useful in furnishing information in the study of sensations, feelings, and emotions, and some forms of intellectual processes. What sensation a person experiences when the light rays from a red object enter his eye, he alone knows. When he sets about to report the nature of such a sensation, he encounters difficulty. If two persons report a sensation of red, the hearer of these reports does not know whether both persons have had the same experience. This difficulty may be illustrated by asking for reports on color sensations from a color-blind person. One who cannot distinguish reds from greens by means of the hues may under certain conditions call a red by its proper name and say that it is different from a green. When brightness and saturation are kept constant, however, such a person finds it impossible to differentiate the two, a fact which shows that his report was not based on a discrimination of hue. This and similar situations which psychology has discovered make it imperative to accept the crude observations of introspection with some skepticism and to check them under various conditions. If these precautions are taken, the introspective reports may be used as scientific data. In so far as introspective reports give data which may be verified by prediction, they are valuable.

2. *Observation of behavior.* The observation of the behavior of an individual in varying situations is another technique which psychology has developed. Very few, if any, of our mental processes take place without some overt behavior accompanying them. Some types of behavior are very easily observed. For example, if a person is learning to operate a typewriter, accurate records may be made of his speed and accuracy as he proceeds which will furnish an objective account of his learning. In other types of activity the overt acts are not so apparent. For example, if one is doing mental multipli-

cation, the various steps involved in the process cannot be followed by an observer. One may observe various grimaces, counting on the fingers, squirming about on the chair, scratching of the head, and the like, but, in this case, if we are to know the various steps by means of which our subject arrives at his solution, we must depend upon his report. If he is clever at controlling his overt behavior, he may be going through numerous intellectual processes without our knowing the nature of these processes at all.

For the man who is to apply his psychology to the practical study of his fellows, the advantages of the method of objective observation are apparent. It is difficult for a person to give a correct introspective report even when he tries his best to be accurate; but if he is not concerned with giving the observer an accurate report, or if he is bent on deceiving him, introspection fails miserably. On the other hand, since the observational technique attempts to interpret all overt behavior, including signs of deceit as well as other acts, it is a valuable technique for the professional man to use in his attempts to study others. If the prospective customer tells a salesman that he is not interested in his goods, only a poor salesman takes the statement at its face value. The student of human nature will look for indirect signs by which to tell whether his customer is really disinterested or whether he is afraid to manifest an interest for fear of buying too hurriedly.

3. *The statistical technique.* We have pointed out the fact that psychological laws must be formulated on the basis of data taken from a large number of observations and from persons who differ in a great many respects. This gives us a large accumulation of observations closely related but differing in degree. The statistical technique was devised to interpret diverse material which otherwise would be too cumbersome to analyze. Statistics is not confined to psychology, but is used in all biological and social sciences where one must get an accurate

measure of variable quantities. In measuring any biological characteristic, it is not enough to have a fine scale of measurement. For example, we have a well-developed linear scale, but this does not enable us to answer in one simple statement the question, " How tall are men? " Since men vary in height, we must answer such a question in statistical terms. We may state that practically all men are within the range of five feet and seven feet. We can supplement this statement by giving the average height of men; or we can state what proportion of men fall within a certain range, say between five feet and six feet. In any particular instance, we can state how far a man deviates from the average of all men. Statistical concepts such as these have been very valuable in the study of psychology.

In using the statistical technique, one should not forget that he is dealing only with an accumulation of data and that these data can do no more than furnish evidence for or against certain psychological or biological theories. A single fact, being merely part of an anecdote, deserves little weight in the proving of a theory; but an accumulation of anecdotal facts provides us with statistical material. Such accumulated material, however, is still nothing more than evidence, making us more or less certain of the theory it involves. It should never be assumed that statistical data obviate the need of experimental verification. Experiment, and not statistics, furnishes the ultimate criterion.

4. *The case-study technique.* The case-study technique involves the accumulation of all the significant data that may be found relating to a particular individual. This technique is especially valuable in indicating the relationship of various factors in the life of the individual — relationships that might not become apparent in the more sketchy investigations that one makes by introspection or by the observation of large numbers of persons.

The beginner in the study of psychology should be very careful not to confuse the case-study method with the mere accumulation of anecdotes. Both anecdotes and case histories are essentially stories relating to the life of the person involved. The difference between them lies in the care with which the case history is prepared to avoid coloring the details with false emphasis or omitting incidents which might be distasteful or seemingly irrelevant. The anecdote is designed to fascinate the hearer; the case history, to present an unbiased statement of facts.

Even if the case history is carefully presented, it does not constitute the best kind of scientific evidence. It is merely the first stage of scientific procedure. It may be valuable in helping the investigator to formulate hypotheses for further study, but data taken from case histories should never be given as much scientific weight as data from experimentation.

While these various techniques of psychology are valuable at various stages in the study of psychological materials, they are merely aids in the execution of the scientific procedures outlined. Experimentation — that is, observation under controlled conditions — is the only way to verify a hypothesis whether the material be psychological or physical in nature. The peculiar techniques of psychology should be regarded as instruments to aid in psychological experimentation.

IV. Various Fields of Psychology

Psychology has various branches so that it properly includes the study of normal persons, abnormal persons, children, animals, and man in his various social situations. General psychology draws from, and in turn contributes to, all these fields.

Materials Used in the Study of Psychology. In attempting to discover the laws which govern human behavior, approaches may be made from various angles. While some of these should be favored because they yield more direct results than others, nevertheless, indirect approaches have sometimes been found to be very fruitful in scientific research. The general psychology which the professional student will find valuable draws from the investigations conducted in a number of fields. Throughout the text we shall not attempt to distinguish the source of the material, but it will help us to orient ourselves if we know some of the fields of science to which psychology is related.

1. *The study of normal human beings.* This approach to the study of psychology seems to be the most direct. If psychology is the study of human behavior, the natural approach would seem to be through the study of normal human beings. However, this approach is not so simple as it appears to be. Great difficulty is presented by the fact that the normal individual is so complex that it is hard to isolate specific characteristics for experimental study. For example, we may wish to study the learning process in the human being, but we soon find that this learning is modified by such things as interest in the work, previous training with similar material, sensory differences, motor agility, and a host of other factors. The only way to proceed is to keep these extraneous factors as constant as possible. In some of the other methods of attack the extraneous factors may be kept more constant than is possible in the study of the normal persons, and hence these other methods are sometimes more valuable.

2. *The study of abnormal individuals.* The procedure in the scientific laboratory is to isolate one element and study it. In the abnormal person we find certain traits so isolated that the person constitutes a ready-made laboratory. Thus, if we find two persons, one with extremely keen and the other with extremely sluggish intellectual ability, an intensive study of the two, with a comparison of their behavior, will tell us things about intellectual ability that we could not learn by studying only persons with normal intellectual ability. The study of

persons with hearing defects, visual defects, organic injuries to the brain, distorted emotions, and other sorts of abnormalities has thrown a tremendous amount of light upon psychology.

3. *The study of children.* In children we may observe behavior in the making and consequently in a relatively simple form. By studying a young child before a certain type of reaction has developed, we can follow the development of that reaction under the influence of external conditions, which we can in many instances control very accurately. The psychology of learning is based almost wholly on observations of the development of children. Experimental work with children is growing apace and is resulting not only in great benefits to the body of knowledge of psychology in general, but also in a marked improvement in our technique of child training. One whose task it is to influence adults may learn much by dealing with children and studying the methods whereby they may be influenced. The executive, the salesman, the physician, the lawyer, the clergyman, and even the policeman would do well to take a course of training in dealing with children before he attempts to manage adults.

A good illustration of the practical value of studying children is the development of the junior police. As long as the police system offered a challenge to the youth to defy legal prohibitions, the police were at a disadvantage. When they learned enough of the psychology of boyhood to enlist boys in their cause through the organization of the junior police, they no longer had them as enemies, but as allies. Boys enlisted in this work get a thrill from obeying the law, whereas they were formerly thrilled by disobeying it.

4. *The study of animals.* Psychology is able to gather much from the study of animals which throws light upon human conduct. The behavioristic approach is, of course, the only one which is of value in this branch of psychology, for obviously we cannot ask animals to introspect.

The first studies of animal psychology were filled with attempts to read into animal behavior what was thought to exist in human behavior, but when the study of animals became objective, it provided many new methods of studying human beings. To be sure, the results of the study of animals cannot be carried directly over into human psychology, but by studying animals, we have developed techniques of observation which are very useful in human psychology and we have formulated many fruitful hypotheses which would have been much less apparent without these studies.

5. *The study of social groups.* Man's conduct is materially modified by the fact that he normally lives his life in association with others and not in isolation. Out of consideration for others or because of the restraints which society naturally places upon him, he cannot do all the things he might like to do. On the other hand, he develops many characteristics which would remain latent were it not for these social contacts. Psychology must therefore study man in his relations with others. Such studies embrace the study of races, religious groups, political organizations, gangs, family relationships, schools, playground activities, mobs, warfare, and other multitudinous groupings of activities and interests.

Summary of the Branches of Psychology. The different branches into which the study of psychology is customarily divided are as follows:

1. *General psychology* is the study of the behavior of the normal human adult.

2. *Physiological psychology* is the study of the physiological foundations of human behavior.

3. *Abnormal psychology* is the study of unusual types of human behavior.

4. *Genetic psychology* is the study of the evolution of types of behavior from their simple beginnings in the race and individual.

5. *Child psychology* is the study of the psychological development of the child from birth to maturity.

6. *Educational psychology* is the study of the principles of learning and teaching.

7. *Psychology of advertising and selling* is a study of the application of psychological knowledge to the processes of exchange — that is, of buying and selling.

8. *Psychology of personnel administration* is a study of the application of psychology to the problems of employer-employee relationship.

9. *Social psychology* is that branch of general psychology which stresses the principles operative in the adjustment of the individual to the various social orders.

10. *Comparative* or *animal psychology* is a study of the behavior of animals, usually for the purpose of obtaining a better understanding of the behavior of human beings.

V. How to Get the Most from Psychology

Two questions to keep before us are: How do men act? and Why do they act as they do? If we assume that there are adequate causes for all conduct, we may be able to discover some of them. One should approach the study of psychology with a real interest in people and a determination to learn what explanations science can give for human conduct.

How Do Men Act? Some persons approach the study of psychology motivated by an interest primarily in themselves. If they can see themselves reflected in every page of the text, they are sure that what has been written is true; if the text describes ways that are different from their own, they are inclined to doubt it. Such an attitude obviously limits their perspective. They lose sight of the all-important fact that, since individuals differ, the understanding of others rests upon a constant recognition of these differences. The approach to psychology should be an impersonal attempt to study life as it is and not as we think it is or wish it to be.

Why Do Men Act as They Do? Man's behavior at every instant is the unified and harmonious reaction to all the factors which influence him. A broad survey of the types of factors which influence behavior will help us to keep this fact of unification and integration before us as we proceed.

1. *Man's surroundings influence his behavior.* We have a kind of receiving apparatus designed to make us aware of some of the things which are going on about us. Because this receiving mechanism is so organized that we cannot be aware of everything, we can respond only to what psychologists call adequate stimuli. These stimuli vary from very simple to very complex forms, have different effects at different times, and are acting in continually changing combinations. Behavior cannot be understood unless we make a complete study of these various factors and their influence. We should recognize as we make a study of a particular situation that it is only theoretically isolated for study and that it never really occurs in isolation. For example, we might make a theoretical study of the effect of a certain sound on a person, but such a study must also consider what the person is seeing, tasting, smelling, and otherwise sensing at the time, how many times and under what circumstances he has heard a similar sound, and what his previous reactions to this sound were.

That these external situations comprise a large part of what a man actually becomes, there can be no question. Man is literally the result of the food he consumes, the family in which he is reared, the comrades he meets and plays with, the bumps and bruises he gets, the landscapes he views, the conversations he hears, the books he reads, the furniture he uses, the clothes he wears, and the successes and disappointments he experiences.

2. *Man's equipment.* That man's adaptation to his surroundings is determined by his innate equipment, there can be

little doubt. Man's finest equipment is his nervous system. The function of the nervous system is to receive all the impressions which impinge upon the sense organs and coördinate and unify them so that man can make adequate reactions to them. Some few nervous connections are definitely established at birth so that in these instances man has no choice of response. For example, if you permit a bright light to strike an infant's eye, his pupil will contract. In the case of the many other situations which bring varied responses in different individuals, the nature of these responses is dependent upon the coördinating function of the particular individual's nervous mechanism.

Other equipment besides the nervous system likewise determines behavior. Because he has four fingers and a thumb on each hand, man acts differently from the way he would if he had ten fingers and two thumbs on each hand. Since his arm is hung on a ball-and-socket joint, he can do things that he could not do if it were a flat-hinge joint. The movements of his vocal apparatus are limited so that he cannot make sounds outside a certain range. There are limitations to the contraction of every muscle and to the strains which any of the bones or tendons can sustain. All these things go to make up man, although we are so prone to take them for granted that we sometimes fail to see their significance.

The importance of motor equipment in the mental development of the individual becomes apparent at once if there is a defect in some part of the motor mechanism. If a child has only one arm, this handicap may induce him to make extra efforts to develop other parts of his body in order to compensate for the lack. On the other hand, he may develop queer attitudes toward society because he is different, may hate others, be jealous of others, may pity himself so that he will not mingle with others, or he may develop even more complex mental characteristics as a result of a simple physical deficiency. Hence, in order to understand people, we must take into consideration the nature of their equipment and how they have been influenced by it.

Attitudes toward the Study of Psychology. What one gains from the study of a subject is largely determined by the attitude with which he approaches it. This book is written primarily for professional students, and it is assumed that these students have an interest in the application of psychology to their professional problems. Because a thorough understanding of subject matter is essential before it may be applied, a student with a practical interest cannot be content with a superficial study. The professional student should study the subject as thoroughly as the student who seemingly has but a theoretical interest, but with this difference: he should continually keep before himself the question, "How may this material be utilized?" Besides this practical interest, the following attitudes will be found helpful if one is to get the most from a study of psychology.

1. *One should have an interest in human beings other than himself.* Get the habit of looking about you at persons, not as so many objects with which you must deal, but as interesting individuals to be studied. Why do they do the things they do? What will they do next? How they bustle about doing bizarre and senseless things which seem to be such serious matters to them! How different they are when you get acquainted with them! This man appeared to be a mean, ill-natured old wretch, but upon acquaintance he proves to be a warm-hearted, interesting person.

2. *Do not expect to solve all human problems.* Do not get the notion that a simple course in general psychology will enable you to answer all questions about human nature. It is the fact that these questions cannot be easily answered that adds zest to the study. What you should get is a technique which will enable you to attack the problems as they arise.

With the partial solutions which may result from your study, you should be stimulated to still further interest in an understanding of human relations.

3. *Avoid the tendency to oversimplify.* One great fault which it is necessary to fight is the tendency to develop a few simple explanations with the expectation of applying them to every situation. Often these explanations are expressed by some simple term and then the term applied indiscriminately. Psychology in the past has been full of errors of this type. One man explains everything by reference to some instinct; another blames everything on the subconscious; another on the internal glands of the body; another on defective teeth; another on poor digestion; another on the sex urge; another on fear; and another on too much love for one's mother. If there is any subject in which one should avoid riding a hobby, it is psychology.

4. *Avoid mysterious explanations.* Human life has always been surrounded with more or less mystery because for so long it defied rational explanation. To permit superstition to creep into our psychology only blinds us to the real problems involved. We shall get nowhere in our explanation of human conduct if we cling to such intangible things as animal magnetism, mental telepathy, and the influence of evil spirits. To be sure, no student will think he is permitting himself to harbor superstitious explanations, but too often we discard some major superstition only to find it is still coloring our views in a different guise. It is well to use the dictum of scientific frugality and refuse to accept a mysterious explanation where it is possible to derive a simpler and more understandable one.

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CHAPTER II

THE HUMAN ORGANISM

VI. General Bodily Structure and Function

In this section we shall discuss the general nature of man's interaction with his environment. He is affected by his environment through the food he eats and the play of external forces on his sense organs. He reacts upon his environment by the activity of his muscles and the secretions of various glands.

Whatever else man may be, he is a very efficient machine. It is the function of a machine to receive energy in one form and to transform and deliver that energy in some different form. Man receives energy from his environment in two ways: first, in the form of food, and second, in the form of external forces impinging upon his sense organs. External forces may be of several kinds, as for example, mechanical forces such as wind, air pressure, and blows from hard objects which drive man into certain postures; or physical forces such as sound and light waves; or chemical forces such as odors and tastes. The food is transformed chemically into different forms of energy and is released upon man's environment as heat and movement. The forces playing upon his sense organs are changed into nerve currents which are conducted to various portions of the body and are released in the form of words, acts, bodily postures, and glandular secretions. Let us consider both these forms of energy in some detail.

The Energy Received from Foods. One of the most apparent sources of human energy is food. Food is taken into the body in the form of (1) proteins, such as meats, (2) carbohydrates, such as sugar, (3) fats, (4) water, (5) vitamins, (6) air, and (7) possibly sunshine. The first five of these are taken into the digestive system through the mouth. The various parts of the digestive system have different functions in changing the form or structure of the food. For example, the physical form of the food, if it be a solid, is changed by chewing. The saliva, gastric juice, pancreatic juice, bile, and other fluids aid in breaking down the chemical structure of the food so that it will be more usable. The proteins are changed to a soluble form, called amino acids; the fats are saponified; and the starches are changed into sugars. In these forms, they may all pass through the walls of the intestines into the blood stream. The amino acids are carried directly to the cells of the body without change. The sugars are carried to the liver and temporarily stored there or are directly released into the blood stream in the form of glycogen. The fats, after being saponified as they pass through the walls of the intestines, are again changed into fats and stored in different parts of the body, especially around the heart and kidneys and over the abdomen. Thus we see that some food is continually being carried to the cells of the body to be used or stored there. Some food is stored in the liver and given out in a constant stream into the blood to be carried to the various cells of the body, and some is stored in more or less free form in different parts of the body.

Air is taken into the body through the nose and mouth from whence it is carried to the lungs. There the oxygen passes through the thin walls of the air sacs and is transported to the cells of the body by the blood. In the cells, it is ready for use in oxidizing the food stored there. But the union of the oxygen and stored food does not take place without the action of a nervous current. The stored food and oxygen are like the air and gasoline in the cylinder of an automobile engine. There must be a spark to set them off. The nervous current is this spark.

Energy Received through the Sense Organs. The second form of energy which affects the human organism consists in different kinds of stimulation which strike upon the sense organs. These stimuli are either in the form of mechanical contact, sound waves, warmth, light, or other forms of electrical waves. These forms of energy, along with many others, are always present in the environment in which man lives. But it is only when they strike upon a receptor, or sense organ, that they have any influence upon the organism. The sense organs are mechanisms designed to receive external stimuli and to transform them into nerve currents. Each particular sense organ is adapted to receive only a specific type of stimulus and that only within a certain range. Stimuli within the range of any sense organ are called *adequate stimuli;* those of the wrong type or without its range are called *inadequate stimuli.* The sense organs do not respond to inadequate stimuli.

There are many forms of energy for which we have no receptors, as may be seen from a study of Table I. We have no sense organs for the adequate reception of electric waves, radio waves, Hertzian waves, solar radiation, ultra-violet rays, X-rays, gamma rays, or cosmic waves. We know of these waves only by indirect means; we cannot perceive them directly with any sense organs in our bodies.

We can perceive physical pressure, within a certain range of intensities, when it is presented to the skin. Physical vibrations from about sixteen a second to about thirty thousand a second are adequate stimuli for our ears and are sensed as sounds. We react to infra-red rays with a vague sense of warmth. Visible rays from 380 trillion to 770 trillion waves per second are adequate stimuli for our eyes and are sensed as light and color.

TABLE I. TYPES OF VIBRATIONS AND THEIR WAVE LENGTHS

(From Clark, *Applied X-Rays,* by courtesy of McGraw-Hill Book Company.)

Type of Wave	*Range of Vibration Rate per Second*
Electric wave	85 to 10,000
Radio wave	10,000 to 30,000,000
Hertzian wave	30,000,000 to 3,000,000,000,000
Solar radiation	56,000,000,000,000 to 1,000,000,000,000,000
Infra-red rays	700,000,000,000 to 380,000,000,000,000
Visible rays	380,000,000,000,000 to 770,000,000,000,000
Ultra-violet rays	770,000,000,000,000 to 22,000,000,000,000,000
X-rays	2,900,000,000,000,000 to 50,000,000,000,000,000,000
Gamma rays	2,100,000,000,000,000,000 to 310,000,000,000,000,000,000
Cosmic (Millikan)	4,500,000,000,000,000,000,000 to 7,500,000,000,000,000,000,000

Although man's sense organs are very limited in the range of adequate stimuli that they can receive, man has overcome this handicap by devising instruments to transform inadequate stimuli into adequate stimuli. By means of photography we may make use of X-rays. The radio utilizes radio waves for the transmission of sound. After transmission, these waves are changed back into oscillations within our audible range. Ultra-violet rays do not affect the sense organs of our skin or our eyes directly, but ultra-violet rays from the sun or from specially designed lamps produce sunburn. They are used to treat skin and bone diseases and to kill bacteria.

When viewed from another angle, the limitation of our sensory range is an advantage rather than a handicap. The purpose of receiving impressions through our sense organs is to enable us to respond to our environment. If we were bombarded indiscriminately with all the forces of energy about us, life would be extremely confusing and we should have a very difficult time learning to respond at all. It is advantageous to be able to tune out all stations with our radio receiver except the one we wish to hear or to tune out all of them if we are annoyed. What if we had to listen to all of them all the time! The selective function of our sense organs is a very important one. Although we exercise selection, we want to be able to sense all that other persons do or we shall be at a disadvantage. We do not want to be aware of everything in the universe, but we want to perceive as much as our neighbors. On this account we strive to devise apparatus to correct any gross defects we may have in our sense organs.

Man's sense organs are not ordinarily affected by all the adequate stimuli in his environment. Because the range of his attention is limited, man cannot attend to all stimuli. He must continually select from those which are presented to him. As he has progressed in civilization, he has developed the capacity to select the types of stimulation to which he wishes to attend. He also has devised methods whereby he can utilize other forms of energy, such as radio waves, whenever he wishes to do so. Thus his intake from the environment is determined by the needs of the moment as well as by his sensory limitations.

Mechanisms of Bodily Activity. Some activity goes on in all cells of the body. There is a constant using up of food through the processes of nutrition, regeneration, repair, growth, and the maintenance of warmth. There are also specialized mechanisms in the body for producing reactions in and on the environment — specifically, the muscles and glands.

1. *The striped muscles.* There are two types of muscles in the body, the striped and the unstriped. The striped muscle is composed of long, slender fibers arranged both in series and in parallel. That is, the separate fibers connect with one another longitudinally in series and these strands are arranged in columns, side by side, to compose the bulk of the muscle. The striping of the muscle is shown in Figure 1. Nerves lead to each fiber of the muscle. When a nervous current enters a muscle fiber, it causes some of the oxygen and food elements stored in the fiber to unite. This union sets up an activity in the fiber which causes it to contract. The contraction shortens the longitudinal dimension of the fiber and increases its diameter. The contraction of any single fiber would produce no significant effect, but generally nervous currents enter many or all the fibers of a muscle simultaneously. The resulting contractions cause a shortening of the muscle.

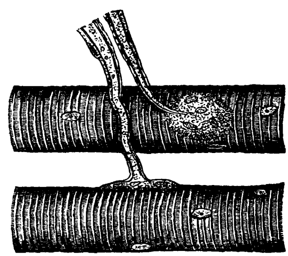

FIG. 1. A STRIPED MUSCLE SHOWING THE ATTACHED MOTOR NERVE

The simple contraction of a striped muscle in response to a single stimulus is illustrated in Figure 2. While the length of time required to react may vary with different muscles, the general nature of the contraction is the same. There is a latent period between the stimulus and the beginning of the contraction. In the illustration, the latent period occupied about 0.01 sec.; the contraction, represented by the rising line, about 0.05 sec.; the relaxation, represented by the falling line, about 0.05 sec.

In ordinary life most contractions of striped muscle depend upon a rapid succession of impulses which combine to produce an apparently longer and slower contraction than that shown in the illustration. It takes a large number of successive impulses to effect such a simple movement as raising the arm. Furthermore, most movements of the body are the result of the contraction of a whole group of muscles either simultaneously or in succession or both.

Muscles are usually attached at one end to a stationary bone or cartilage and at the other to a movable bone or cartilage.

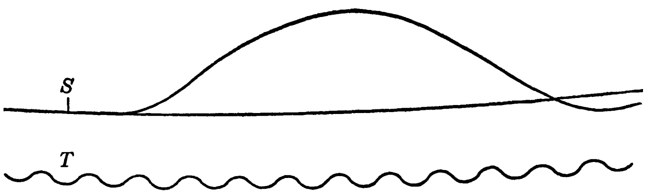

FIG. 2. GRAPHIC RECORD OF A SIMPLE STRIPED-MUSCLE CONTRACTION

S indicates the point at which the stimulus was applied. When the muscle contracts, the curve rises; as it relaxes, the curve falls. T is the time line, each wave representing one-hundredth of a second. (Adapted from Gates, *Elementary Psychology,* copyright, 1925, by The Macmillan Company. Reprinted by permission.)

The shortening of the muscle causes a movement of the free part. In some cases, however, muscles of the body are arranged in bands and are not connected at both ends with bone or cartilage. The muscles of the tongue and face are examples of this type. In either case movement of some part of the body is produced by the contraction of a muscle or muscles. This movement is essentially the same in character whether it consists in movements of the legs, as in walking; of the tongue, as in talking; or of the face, as in laughing.

2. *The unstriped muscles.* The unstriped muscles are generally flat and sheetlike or tubular. (See Figure 3.) The cells are flatter and shorter than those in the striped muscles. The

cells also merge into one another, producing a somewhat amorphous structure. The diaphragm and the walls of the intestines are composed of unstriped muscles.

The most distinctive difference between the functioning of the smooth muscles and that of the striped muscles is the relative sluggishness of the smooth muscles. The latent period may be from fifty to five hundred times as long as that of the striped muscle. This relatively sluggish activity is indicated in Figure 4. Here the latent period is about sixty times as long as in the contraction of the skeletal muscle illustrated in Figure 2. Moreover, the period of contraction of the smooth muscle in Figure 4 is about sixty times as long as that of the skeletal muscle in Figure 2. The slowness of relaxation is still more striking. Whereas the striped muscle relaxes about as quickly as it contracts, the smooth muscle relaxes very slowly, consuming four or five times as long a period as is required for contraction.

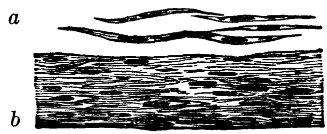

FIG. 3. AN UNSTRIPED MUSCLE

(*a*) Isolated fibers, (*b*) Muscle tissue showing many fibers joined together.

This difference is very important when we consider how each type of muscle enables us to adjust ourselves to our environment. The skeletal muscles respond quickly and enable us to make rapid and violent adjustments to our surroundings. The smooth muscles, on the other hand, are primarily involved with nutritive adjustments. They are also a part of the type of reactions which we shall consider as emotional reactions. This fundamental characteristic of smooth-muscle contraction explains why emotions develop slowly and persist much longer than a simple skeletal reaction. The slowness of recovery from an emotional reaction is accentuated by glandular factors, as we shall soon see, but the fundamental cause seems to lie in this inherent difference in the speed of reaction between skeletal and smooth muscles.

3. *Cardiac muscle.* A third type of muscle is sometimes mentioned — namely, cardiac muscle. The muscle of the heart is banded muscle, but the bands are not like those of striped muscle. The separate fibers are fused together at various points, producing a network of fibers. However, cardiac muscle functions more like unstriped than striped muscle.

4. *Glands.* A gland is essentially a mechanism for taking certain substances from the blood, reorganizing them, and de-

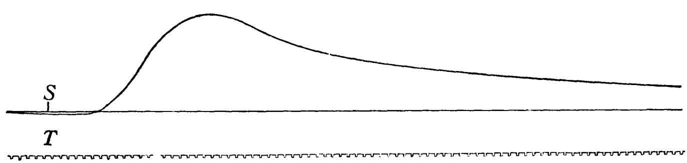

FIG. 4. GRAPHIC RECORD OF A SIMPLE SMOOTH-MUSCLE CONTRACTION

S indicates the point at which the stimulus was applied. As the muscle contracts, the curve rises; as it relaxes, the curve falls. The bottom line T is the time line, each wave representing one-hundredth of a second. (From Howell, *Physiology,* W. B. Saunders Company.)

livering them again to the blood stream, to some other part of the body, or outside the body. All glands may be divided into two general classes. The first (see Figure 5) are the duct glands, so named because their secretions pass from the gland through a duct or opening. The second (see Figure 6) are ductless, or endocrine, glands, so named because their secretions pass directly into the blood stream.

The primary function of duct glands is to assist in the smooth functioning of our vegetative organs, but at the same time they are intimately related to our mental life, as is illustrated in the changes produced in these glands by what are usually called emotional stimuli. For example, the tear, or lachrymal, glands serve to keep the eyes sufficiently moist, but they also take a prominent part in our response of crying. The salivary glands and gastric glands furnish assistance in the digestive processes, but their activity diminishes when we are afraid or angry.

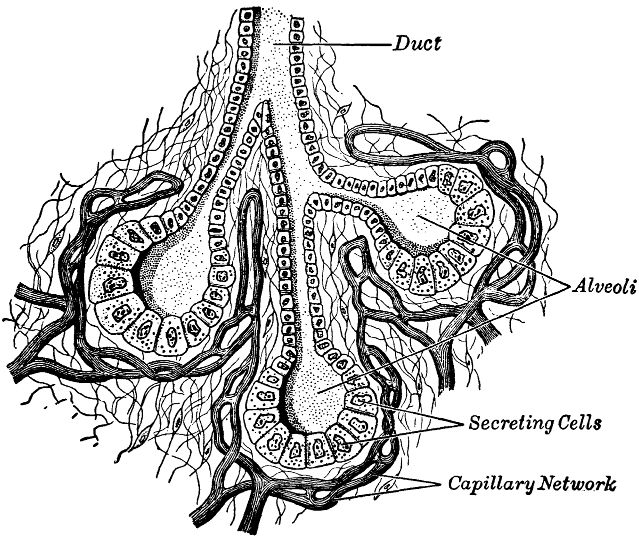

FIG. 5. A SIMPLE GLAND WITH CONNECTIVE TISSUE AND BLOOD VESSELS

(From Hough and Sedgwick, *The Human Mechanism,* Ginn and Company.)

Ductless glands are more subtle in their influence. Until recently the nature of their activity was little understood, but we now know that they have a marked influence upon our general mental and emotional life as well as upon our physical development. Atrophy of the thyroid gland, for example, is accompanied by mental deficiency as well as gross physical abnormalities. Excessive functioning of this gland produces, or is accompanied by, rapid heart activity, overactivity of various sorts, and often by emotional instability.

The adrenal glands are closely associated with emotional reactions. When one is aroused by an emotional situation this gland is stimulated and, as a result of its secretions, the activity of the body is increased, the heart beats more rapidly, stored foods are made more available, and breathing is accelerated. The secretion of adrenalin also acts as a means of prolonging the duration of the emotional reaction. If adrenalin is injected directly into the blood stream of an animal in repose, the animal will show signs of excitement such as usually result from an emotional situation.

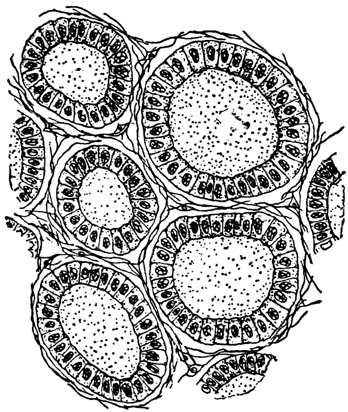

FIG. 6. CROSS SECTION OF A DUCTLESS GLAND

The cells secrete into the closed sacs which they surround. The secretion then passes out between the cells into the lymph spaces of the connective tissue. (From Hough and Sedgwick, *The Human Mechanism,* Ginn and Company.)

The pituitary body is another ductless gland which affects mental life. While its effect is most marked in the bodily structure, its over- or underdevelopment is also associated with intellectual deficiency.

Other glands in the endocrine, or ductless, system which have a more or less direct relationship to mental life are the parathyroids, the thymus, the pineal body, the pancreas, the liver, and the sex glands.

The activity of the glandular system in relation to mental life should not be ignored even though it is often of a vague and non-specialized nature. A child may be blamed for lacking ambition or for being slow and lazy, when he may need some thyroid extract. Another may be punished for incessant activity or be ridiculed for his excessive sentimentality, when the cause of his behavior is the overactivity of his thyroid. The importance of glands should not be overstressed but, on the other hand, it should not be ignored.

The character and the extent of activity of both muscles and glands depend upon (1) the food supply of the organ, (2) its physiological condition at the time, which makes it either susceptible or relatively unsusceptible to stimulation, and (3) the nervous impulse. The determination of whether there will be activity or inactivity, as well as the determination of the form of any activity that takes place, depends upon the existence and balance of these three factors.

Our discussion thus far has dealt more with the problems of physiology than with those of psychology. This has been necessary because we cannot get an adequate conception of the working of the human organism without understanding the source of the great energy it expends. It is from the food we eat that this energy comes. Too often the psychologist has been interested only in the part of the process which we are now ready to describe — namely, the stimulation of the sense organs and conduction of nervous energy to different parts of the body.

VII. The Central Nervous System

In this section we shall describe enough of the structure of the nervous system to enable us to understand its functioning. The unit of nervous structure is the neurone. Neurones are combined so as to form a network of connections to all parts of the body with their centers in or near the brain and spinal cord.

The nervous system, the function of which is to conduct nerve currents to different parts of the body, is very complex and intricate. Like other parts of the body, it is made up of cells. These cells, microscopic in diameter, may be of various lengths, from a few thousandths of an inch up to three or four feet. These nerves connect with one another to form a whole system of interconnections. They may be arranged in thin strands, as are those that run from the sense organs to the

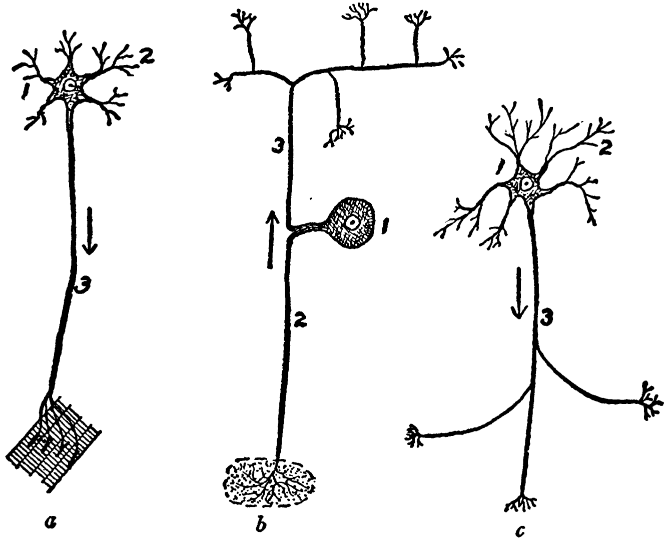

FIG. 7. SOME COMMON TYPES OF NEURONES

(*a*) Motor neurone, (*b*) Sensory neurone, (*c*) Association neurone.

muscles, or they may be in large groups, as they are in the brain and spinal cord.

The Neurone. A single nerve cell is called a *neurone*. Although neurones differ greatly in general form, they all consist of three parts: (1) a cell body, (2) a dendrite, and (3) an axone. These parts are illustrated in Figure 7. In these drawings of typical neurones (1) is the *cell body*, (2) is the *dendrite*, of which there may be several for each neurone, and (3) is the *axone*. The fine, arborized ends of the dendrites and axones are called *end-brushes*.

The cell body forms the bulk of the neurone. It contains the nucleus and the food supply for the neurone. If any part of the neurone is severed, the part distal to the cell body will die. The cell bodies of all nerves lie in or near the spinal cord and brain.[1] There are no cell bodies along the nerve pathways in the body. All the neurones which extend to distant parts of the body have their cell bodies in groups, called *ganglia,* within or near the spinal column or in centers within the brain.

The branch of the neurone which carries the nerve current toward the cell body is called the dendrite.[2] The branch which carries it from the cell body toward the next neurone is called an axone. Ordinarily a neurone has more than one dendrite, but only one axone, although there are exceptions to *both* of these statements. The dendrites are generally shorter than the axones, but in the case of the dendrites which run from the sense organs to the cord the dendrite is much longer than the axone. There is one other difference between dendrites and axones. The axones are covered with a whitish insulating material called the *myeline sheath.* The cell body and dendrite are grayish in color and are not myelinated.

The point where one neurone connects with another is called a *synapse.* Unlike electric wire connections, neurones meet

[1] This categorical statement is made for the sake of simplicity and brevity. The authors are aware that there are cell bodies in the retina and that the autonomic nervous system has cell bodies in its ganglia. But genetically, the retina is a part of the brain and here we are concerned only with the central nervous system.

[2] This is a functional definition of a dendrite. There is some question whether the part of the sensory neurones which lead from the cutaneous sense organs to the bipolar cell bodies of the spinal ganglia should be called dendrites or axones. Structurally, they are like axones, but they carry nervous currents toward their cell bodies. Therefore, they violate either definition and it makes little difference which we call them.

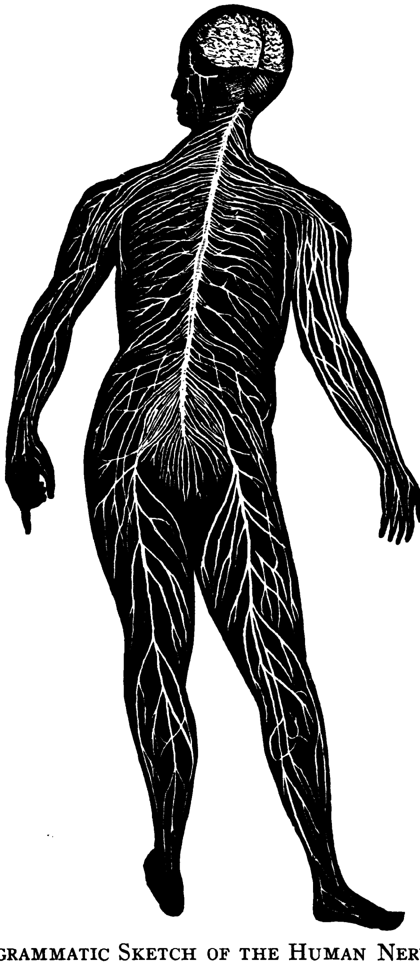

FIG. 8. DIAGRAMMATIC SKETCH OF THE HUMAN NERVOUS SYSTEM

only at their ends, or terminals. One neurone never connects along the side of another neurone unless there is a branch there to which it connects. All synapses of the central nervous system, except those in the retina of the eye, are in the spinal cord or brain. A nervous current, when it is generated in a receptor, must go to the spinal cord or brain before it can be transferred to a motor nerve and carried to a muscle or gland.

Gross Structure of the Nervous System. The nervous system consists of two large systems of pathways and two central, or coördinating, centers. The coördinating centers lie in the brain and spinal cord. Into these centers pathways extend from the receptors of the body. These are definite pathways in toward the spinal cord and brain. Nervous currents passing over these pathways travel only in one direction. There can be no switching until a synapse is reached. There is another set of pathways that lead from the brain and cord to the muscles and glands of the body.

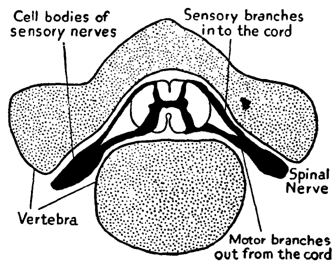

FIG. 9. CROSS SECTION OF A VERTEBRA SHOWING THE RELATIVE POSITION OF THE CORD

The Spinal Cord. The bulk of the spinal cord consists of pathways leading upward from the sense organs and downward to the muscles. The large groups of fibers in the legs, which collect into larger and larger groups and finally into one large trunk, enter the middle of the spinal column at its lower extremity. This is the beginning of the spinal cord. Nerves from higher up — that is, from the thighs, small of the back, and arms — enter this trunk between the vertebræ. The cord, therefore, gradually gets larger toward the upper end of the spinal column. (See Figure 8.) It grows from a thin strand not much more than an eighth of an inch in diameter at its lower end to nearly a half inch in diameter at the base of the brain. Thirty-one pairs of nerves, called spinal nerves, have entered it during this course. Figure 9 shows the position of the cord in relation to the vertebræ and Figure 10 shows a cross section of the cord, indicating its principal sensory and motor pathways.

In addition to the pathways toward the brain, which are called *sensory pathways*, the cord contains approximately the same number, known as *motor* pathways, which lead down toward the muscles. Branches of the motor nerves extend outward between the vertebræ. Very shortly after leaving the cord, they are bound in with the sensory fibers from the region to which the motor fibers are going. It is only when the motor

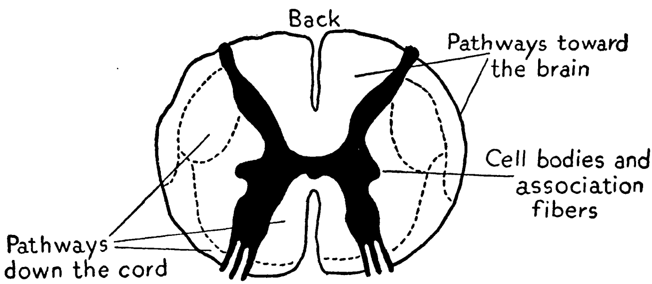

FIG. 10. CROSS SECTION OF THE CORD (MAGNIFIED) SHOWING IMPORTANT SENSORY AND MOTOR PATHWAYS

fibers reach the neighborhood of the muscles which they supply that they branch off from the sensory fibers.

Besides being a series of pathways up to and down from the brain, the cord is a primary switching center. Fibers coming into the cord connect with fibers going out to the muscles of the trunk and limbs. These connections are accomplished by contact between the axones of the sensory neurones and the dendrites of the motor neurones or by short interposed association neurones. It is through such connections that we get the simplest and most rapid reactions of the body. We shall describe this process more in detail after we have further described the structure of the nervous system.

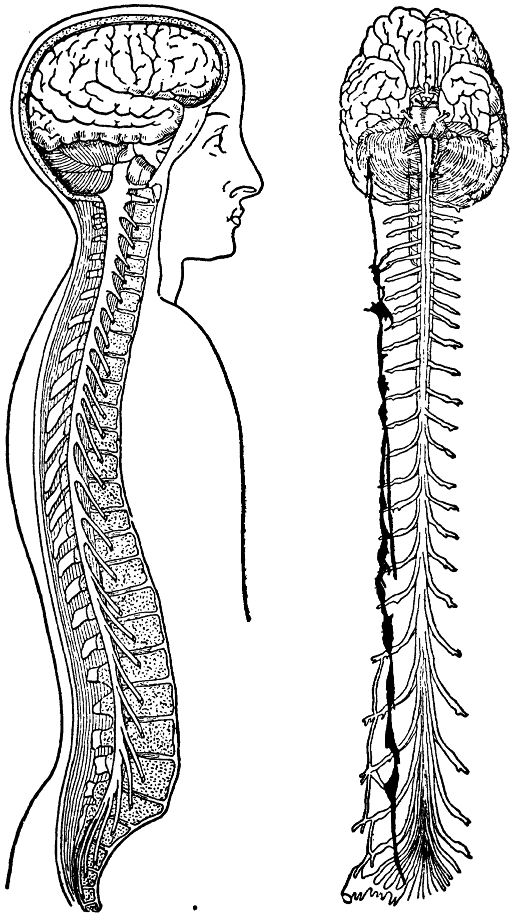

FIG. 11. SCHEMATIC REPRESENTATION OF THE BRAIN AND SPINAL CORD SHOWING THE MAIN BRANCHES OF SENSORY AND MOTOR FIBERS

The Brain. The brain consists of (1) continuing pathways up from the spinal cord, (2) nerve centers, which are the highest centers for the various functions of control, (3) association pathways, which connect one set of centers with another, and (4) pathways down toward the muscles.

We may liken the whole nervous system to an automatic telephone system. The fibers coming in from the sense organs are like the lines leading from the subscribers' telephones. The spinal cord is the main cable to and from the central station. The brain is the central station in which there are lines leading to and from the switchboard and from one plug in the board to another. The plugs in the switchboard correspond to the nerve centers. The connections between plugs are the association fibers of the brain.

This analogy may give a rather clear idea of the way in which the brain functions, but there are a few respects in which it may be misleading. In a telephone system a telephone may either call or be called. In fact, the conversation is generally back and forth. In the nervous system there is a separate system, one for carrying messages in to the central station and one for carrying messages out. Again, in the telephone system the central connections are made by changes in electrical resistance operating mechanical switches. In the nervous system there are actually either direct or indirect nervous connections between each center and all the other centers of the brain. These connections are always there, ready to function. About four-fifths of the brain consists of these connecting pathways. These fibers run in every direction. We can by patient effort trace many of them in the brain; millions of others are too fine and intricate to trace.

While discussing the brain, it should be pointed out that some sensory nerves enter the brain directly without coming through the spinal cord. There are also motor nerves, arranged in pairs, that pass out from the brain to muscles and glands within the head and neck. There are twelve pairs of these nerves, which are called *cranial nerves*. The sensory parts of these nerves come from sense organs in the eye, nose, tongue, and ear, as well as from the cutaneous areas of the head. The motor parts lead to muscles and glands of the face and throat, to muscles within the eye, and to the muscles that move the eyeballs. One of the cranial nerves — the tenth or vagus nerve — even extends to the heart and to parts of the viscera.

Parts of the Brain. Before continuing with our description of the functioning of the nervous system, we should briefly consider the gross structure of the brain. An outside view of the brain presents the appearance of a grayish, wrinkled, egg-shaped mass about eight inches in its longest diameter and six inches in its shortest diameter. The smaller end is toward the forehead. The main mass of the brain is divided into four parts: namely, (1) the medulla, (2) the cerebellum, (3) the mid-brain, and (4) the cerebrum.

1. *The medulla.* The small part at the back which connects with the cord may really be considered as an enlarged extension of the cord. It is called the *medulla*. The medulla is composed mostly of pathways up and down between the cord and the brain. In addition to these pathways there are some connective centers between sensory and motor pathways. Some of these centers are very important, having control of such vital functions as respiration and circulation.

2. *The cerebellum.* Surrounding and slightly above the medulla is a larger, compact part of the brain called the *cerebellum*. Fibers connect the cerebellum with the medulla below and with the other parts of the brain above. We are not certain as to all the functions of the cerebellum, but we know that it has some very direct relation to the sense of balance and to body tonus. An animal with the cerebellum removed will not

maintain an upright position. It may even lie on its back. There is also a continual quiver or jerking in the body muscles.

3. *The mid-brain.* The part of the brain just above the medulla and cerebellum is the *thalamus* or *mid-brain.* Some authors name these as separate parts, but the line of division

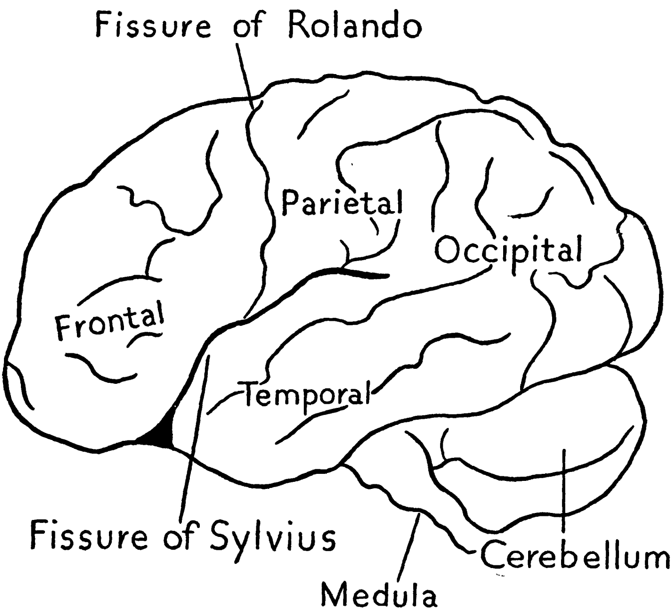

FIG. 12. DIAGRAM OF THE BRAIN SHOWING THE IMPORTANT LOBES AND TISSUES OF THE CEREBRUM

between them is not clear and, in general function and structure, they are so similar that we can not easily distinguish between them. The mid-brain is almost entirely covered on top with the other parts of the brain. This region, like the medulla, has two functions. It is the region through which all the pathways to and from the higher brain centers must pass, and it is also a part in which there are many coördinations between pathways. It is probable that most of the more complex acts which are not conscious are controlled through the mid-brain.

4. *The cerebrum.* The main part of the brain is called the *cerebrum.* It constitutes more than half of the brain and controls most of the higher processes of skill and thinking. (See Figures 12 and 13.) It is this part of the brain which was last

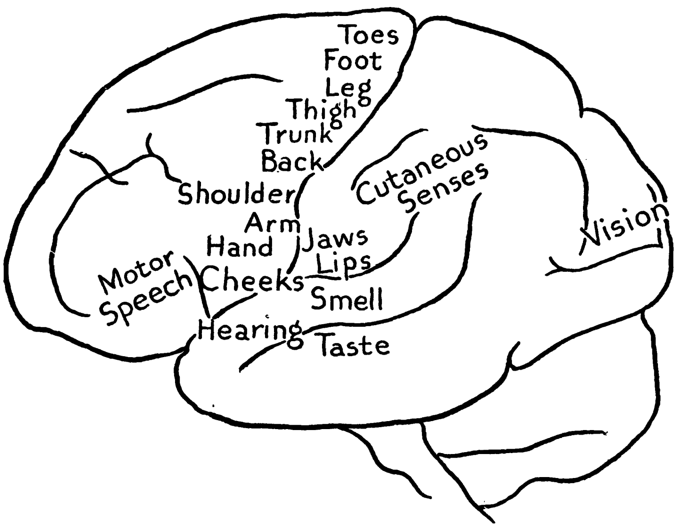

FIG. 13. DIAGRAM OF THE BRAIN SHOWING THE PRINCIPAL SENSORY AND MOTOR CENTERS OF THE CEREBRUM

to develop in the evolution of animals. Even in animals as high in the scale as fishes, the cerebrum is little developed. Only in the mammals, and especially in the primates, like the monkey and man, has it reached a high state of development. It is the last part of the brain to develop in the embryo and, in its development, it folds back over, and almost completely covers, the other parts of the brain. The *cortex,* or outside layer of the brain, is folded into many ridges called *convolu-*

tions. The convolutions make possible a larger surface of cortex. At one time it was thought that the number of convolutions in the brain was an index of intelligence. This view has long since been disproved. There is, as yet, no way by which we can tell from an examination of the shape or structure of the brain anything about the intelligence of the individual, except in the case of very low-grade idiots. Sometimes the brains of such persons are very simple in general structure and contain relatively few nerve cells.

Divisions of the Cerebrum. The cerebrum is divided by three very large and deep creases called *fissures*. One of these, called the *central* or *median fissure,* runs from the middle of the forehead straight backward, dividing the cerebrum into halves. Each of these halves is called a *hemisphere*. Often the cerebrum is spoken of as "the hemispheres."

A second fissure, called the *fissure of Rolando,* starts about the middle of the median fissure and extends down toward either ear in each hemisphere. A third fissure, the *Sylvian fissure,* starts in the temple region and runs backward and slightly upward in each hemisphere. This separates the lower part of the hemispheres from the upper part. These fissures do not completely sever the parts one from another, but they do run deeply enough to be easily distinguished from the other more shallow fissures between the convolutions.

Each hemisphere is ordinarily divided into four lobes for ease in locating any point or area in it. The Sylvian and Rolandic fissures help to mark off these lobes. The frontal lobe is in front of the fissure of Rolando; the temporal lobe is below the Sylvian fissure; the parietal lobe is just back of the fissure of Rolando. There is no clear line of demarcation between the parietal lobe and the occipital lobe, which is at the back of the brain. Figure 12 shows these lobes.

Very important functions are located in each of these lobes. All the sensory pathways end in centers in the parietal, occipital, and temporal lobes. The center for vision is in the occipital lobe. Touch, warmth, cold, and pain are located in the parietal lobe; smell and taste, in a depressed area between the temporal and parietal lobes; and hearing, in the temporal lobe. (See Figure 13.)

All nervous impulses from the brain to the muscles pass through the motor area which is in the frontal lobe just in front of the fissure of Rolando. If the brain is laid bare and this area is directly stimulated with weak electric shocks, movements of different parts of the body are produced. There is some evidence that the area in front of the motor area has some special relation to acts of skill and thinking. Yet the work of Lashley and others in removing parts of the brains of monkeys and other lower animals indicates that the whole brain seems to be concerned in skilled acts, rather than any particular part of it.

VIII. The Autonomic Nervous System

> The autonomic nervous system has the special function of coördinating and controlling impulses to the smooth muscles and glands. Its centers are located outside the spinal column and its activities are closely linked with emotional behavior.

The parts of the nervous system which we have been describing are usually referred to as the central, or the cerebrospinal, nervous system. In addition there is a semi-independent system called the *autonomic nervous system*. It consists of a series of ganglia or groups of cell bodies located along the spinal column but outside the vertebræ. In addition to these, there are ganglia in the pit of the stomach, in the heart, and in a few other places in the body. Sensory fibers lead into this system by branches from the central nervous system. There are probably some sense organs in the viscera which are connected directly with the autonomic system. Motor fibers lead from the

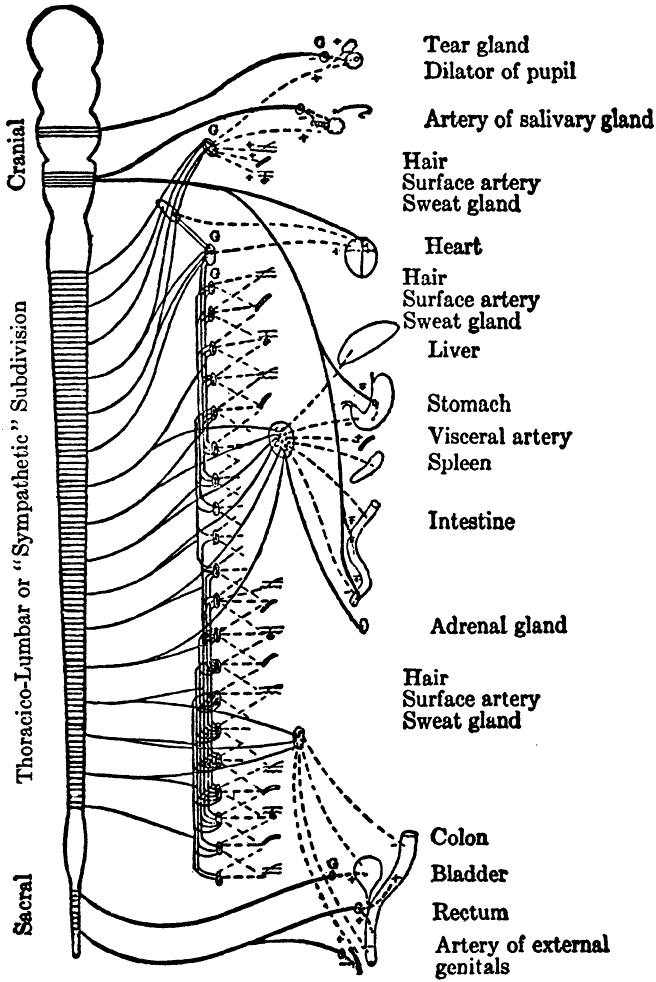

FIG. 14. DIAGRAM OF THE AUTONOMIC NERVOUS SYSTEM

The sympathetic division connects with all the organs; the cranial, with organs in the upper part of the body; the sacral, in the lower. (From Cannon, *American Journal of Psychology*, Vol. 25, p. 257.)

autonomic system to the smooth muscles of the body and to the glands. The general arrangement of the autonomic nervous system and its connections with the various organs composed of smooth muscles are illustrated in Figure 14.

The autonomic system is divided into three parts and named according to the part of the body in which its ganglia are located. These parts are: (1) the cranial, located in the head and neck, (2) the sympathetic, located in the chest and abdomen, and (3) the sacral, located in the pelvic regions.

This nervous system has control over the involuntary activities of the body, such as those of digestion and circulation. The autonomic system is also directly concerned with the feelings and emotions. Therefore, we shall defer a further discussion to Chapter X, except that we should mention here that the different parts of the system tend to work in opposition. The cranial and sacral divisions are paired against the sympathetic division. For example, the cranial division accelerates peristalsis in the stomach and intestines and retards the action of the heart. The sympathetic division retards peristalsis and accelerates the heart. The sacral division accelerates the activity of the colon and the sympathetic division retards its activity.

IX. How the Nervous System Functions

After this brief account of the structure and functions of the different parts of the nervous system, we shall consider how it functions as a whole. We shall treat of these activities in two ways. The first will be concerned with the character of the response itself, as to whether it is kinetic or postural; the second will be concerned with the harmony or lack of harmony of the responses in relation to each other.

Muscle Tonus. A muscle is in a passive, flabby state when not innervated. But muscles are seldom in this condition except in sleep or when the nerve connection is severed. Normally, during waking hours, all the muscles of the body are in a condition of partial contraction. We call this *tonicity.* Tonicity depends upon slight nervous currents which continuously flow into the muscles. The amount of this flow, with its accompanying tonus, varies under different conditions. In dejected states, it is low; in emotional excitement, it is high. Under certain conditions it may be so strong that the muscles become rigid.

Tonus plays a very important part in life activities. For example, the position of the body is maintained by the tonus of the muscles concerned. We sit upright by the maintenance of tonus in the opposing muscles of the trunk and neck; we stand by maintenance of tonus in the leg muscles.

An athlete is "set" differently for different performances. The runner may or may not make any overt movement to the signals "Get ready," "Get set," but he does make tonic changes. A bowler or a baseball pitcher has the "feel" of the movements he is to make.

This tonic condition of the muscles probably also plays an important part in the mental processes in life. Dashiell suggests that this constant body set is the central background for personality. It is the broader, more constant background of life upon which the more transitive process of thinking is superimposed.

Attention is a matter of set or tonus. We attend to certain sounds from the car we drive. We are set to listen for a certain knock in the engine. This set of attention consists of two elements. The first is a general bodily attitude. In attending, the general bodily tonus is raised. The body is erect or bent forward, the head is held erect, the breathing is shallower, the heartbeat is accelerated. In addition to the general bodily position, there is a second element — namely, an adaptation of the sense organs. If we are listening, we turn our heads to give our better ear the advantage. If we are looking, the eyes are fixated on the object of attention. In smelling, we sniff the odor. In tasting, we move the substance to the most advantageous position in the mouth.

We set ourselves to different mental tasks. Dashiell arranged a series of simple problems in addition, subtraction, multiplication, and division. To one group of observers, he gave the problems arranged according to the different processes; that is, all the addition problems were placed together, all the subtraction problems together, etc. To another similar group, he gave the same problems arranged in mixed order; that is, an addition problem might follow a problem in multiplication, and it, in turn, be followed by a problem in subtraction. The time required for solving the problems when they were in mixed order was about fourteen per cent longer than when they were arranged by processes. This additional time may be considered as being due to the necessary shifts in set for the different processes.

A person in the presence of another adopts a set or attitude toward him. Toward some individuals we take an attitude of submission; toward others we take a domineering attitude. The salesman presents an attitude toward the prospective buyer. The writer well remembers suddenly coming upon a representative of one of the larger book companies. The book salesman was not expecting to meet the writer for a few moments. He was not " set " for the interview, and as a result, he had little to say. He was " rattled." Had the meeting occurred a few moments later, when he was set for the interview, he would have been composed.

Ordinarily, when we think of response, we think of overt movement. We call such responses *phasic responses*. They have been illustrated in Figures 2 and 4. Such responses consist of the contraction of muscle tissue due to nervous impulses of sufficient strength or amount to produce movement. While the movement has the appearance of a single simple contraction, all movements are due to a series of innervations instead of a single nervous impulse. These innervations come to the muscle at the rate of 50 to 60 per second. In this way, the effect is cumulative. The result is a movement of greater or less strength and amount, depending upon the nature and extent of these cumulative innervations. Thus we may briefly describe the basis of our active adaptations to life situations.

The tonic contraction of the various muscles of the body, coördinated and controlled through the nervous system, is, in reality, a continuous adjustment to our environment. In sleep we make very few adjustments and our tonus is low. When alertly awake, our adjustments are quicker and more violent. Sitting, standing, and attentive postures are all reactions, and movement is simply the result of a change in balance of innervations.

Facilitation and Inhibition. If my arm is at rest, the flexor and extensor muscles are in the same degree of tension. The arm may be at rest if both of these are either very relaxed or very tense. Movement depends upon a breaking of the balance between antagonistic muscles. It is apparent that if any movement is to take place, there must be some sort of harmony in the innervations of the various muscles. If I am to flex my arm, certain muscles must combine to produce this movement. Such coöperation is called *facilitation*. At the same time the extensor muscles must coöperate by failing to contract as strongly as the flexor muscles. This is accomplished by a weakening of the nerve currents to these muscles and a consequent weakening of contraction. This weakening of contraction to enable the antagonistic muscles to operate freely is called *inhibition*.

No part of the nervous system is completely isolated from the rest. Experiments have proved that such a simple reaction as the knee jerk — a kick response elicited by striking the leg just below the knee — is modified if the subject grips with his hand or even thinks during the response.

As we have already stated, when two activities are more or less opposite or antagonistic, we say that one tends to inhibit the other. Inhibition may take place in such simple activities as reflexes; or it may take place in complex life situations, as when stealing or lying is checked by the development of certain social or moral codes. Facilitation is of the same general character except that one response tends to aid, rather than oppose, the other. Hunger, for example, facilitates general bodily activity.

Conflict and Integration. Closely related to inhibition and facilitation are two other characteristics of behavior: namely, *conflict* and *integration.* When we are stimulated to make two opposed responses, the situation cannot help leading either to one of two mutually exclusive acts or to a compromise between the two. When the responses are rather complex in nature, we give them the name of *conflict.* Conflicts exist in the life of every individual. It is only when they become extreme or too numerous that they result in abnormal conditions.

There is a general tendency of any organism, whenever possible, to react as a unit. This we call *integration.* Although, as we have just said, conflicts inevitably exist, the normal person tends to integrate his activities whenever and wherever it is possible. Integration of the right sort results in a better adaptation to life. The better integrated we are, the better adjusted we are. Learning may be looked upon as the formation of integrated responses toward the environment. In its simpler forms, learning consists in an adaptation and an orderly sequence of all activities going on simultaneously or in immediate succession. In its complex forms, it consists in the ordering and arrangement of life processes according to some principle or standard.

The Reflex as an Integrative Mechanism. Integrative activity takes place as a result of some stimulation of a sense organ. The stimulation of a sense organ sets up a nervous current in the nervous system. If this current is strong, or of a particular kind, it runs directly to the cord or brain — to the cord if it comes from any part of the body except the head or neck, and to the brain, through one of the cranial nerves, if it comes from the head or neck. When such a current reaches the first synapse, it switches to a motor neurone, runs out to a muscle, and produces action. It does not run indiscriminately

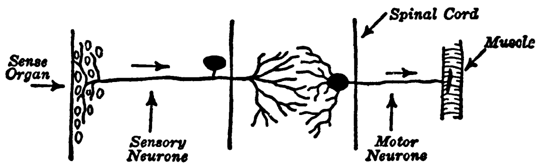

FIG. 15. THE MECHANISM OF A SIMPLE REFLEX ARC

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to any muscle. The one to which it goes depends upon (1) the nature of the nervous current, (2) the part of the body from which it comes, (3) the organization of the nervous system in that particular region, and (4) the previous experiences of the individual.

We may understand these facts better from an illustration. Suppose that a bright light was unexpectedly thrown upon the eye. The light would set up a nervous current in the sense organs of the eye. This nervous current would run to the reflex center in the thalamus and from there, because of the nature of the current and the place from which it came, it would go out over one of the cranial motor nerves to the muscles of the eyelid. This would cause the eye to close. The nervous mechanism consisting of (1) a sensory pathway, (2) an association pathway, and (3) a motor pathway over which such a nervous current passes is called a *reflex arc.* (See Figure 15.) The total time required for the functioning of such a reflex arc is approximately one-twentieth of a second.

Let us consider another example. A man seated before a telegraph key is told to press the key as soon as he hears the signal to start. In this case, the sense organ in the ear is stimulated. The current goes to the mid-brain, and from thence, by

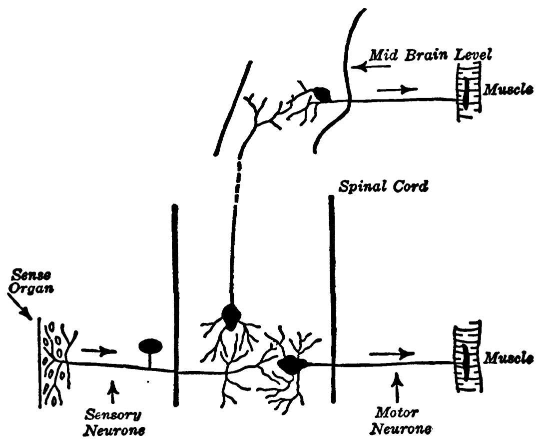

FIG. 16. THE MECHANISM OF A MORE COMPLEX ARC

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way of the cord, to the muscles of the forearm and fingers. We also call the nervous pathway for such an act a reflex arc.

In these examples, the nervous current passes over relatively simple pathways without necessarily entering the cerebrum. The examples differ, however, in that in the first one, the nature of the stimulus and of the nervous pathway determined the form of the response; that is, the pathway over which the current passed was the one which offered a lower resistance than any other pathway. In this case the lower resistance is inherited. In the second example, the lower resistance is due to the previous training of the subject.

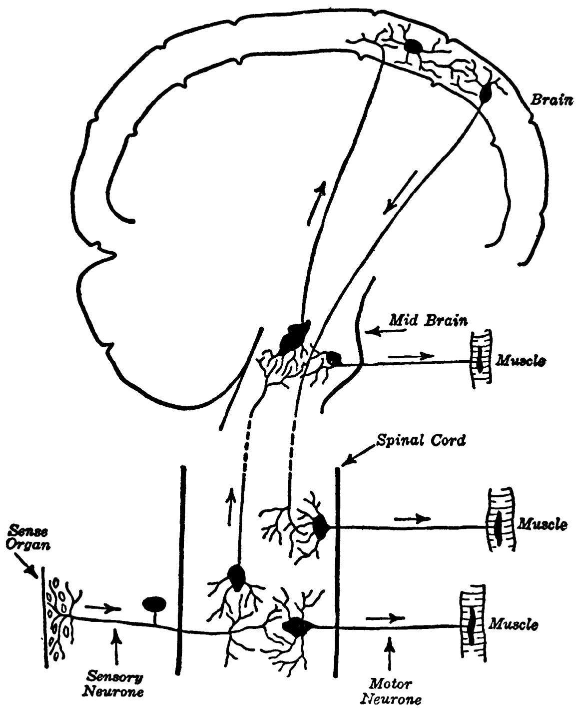

FIG. 17. THE MECHANISM OF A REFLEX ARC INVOLVING CEREBRAL ACTIVITY

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Complex Behavior Patterns. Most behavior is more complex than the examples we have just described. If we are walking over rough pavement, busily engaged in conversation, and strike our toe on a rock, the nervous current goes from the sense organs in the foot to the cord. Part of it runs over the motor pathways back to the muscles of the leg. Another part runs up the cord, probably to the mid-brain, and then out to the muscles of the shoulders, arms, and neck. This all produces a coördinated response which checks our tripping or puts us in position to protect ourselves in the fall. Such a reaction is illustrated in Figure 16.

In this example part of the act is due to the innate character of the pathways and part is a result of training. In fact, in almost all complex acts, some part is due to training. If the whole pattern is predominantly hereditary, we call it a *native response;* if most of it is a result of training, we call it a *learned response.* But as we have already pointed out, this difference is generally one of degree only.

Much of our activity is more complex than any we have yet described. Much of it is also conscious. All the more complex acts and certainly most, if not all, conscious activity is controlled through the cerebrum. Figure 17 illustrates how the cerebrum is involved in a complex response. The cerebrum is the highest center and may exercise control over the lower centers. Yet the nature of the pathways over which the nervous current passes to the cerebrum differs from the others only in complexity. We have no evidence that any new principle is present in such behavior.

When we think, there is some kind of sensory stimulation which sets the process off. The nervous current goes to the cerebrum and relatively much greater elaboration and coördination results than in the lower-order habits. The form of response consists in incipient movements of muscles in the throat or in certain body sets, as in thinking; or in overt movements, as in speaking; or in gross movements of some parts of the body, as in running.

The Conditioned Response. In this discussion we have not always distinguished between learned and unlearned, or innate, behavior. Illustrations have been drawn from both sources.

We shall now consider further differences between these two and indicate how learned responses are developed.

The child is born with certain predispositions to respond to certain kinds of stimuli in certain definite ways. In terms of the nervous system this means that there is an inherited lower resistance in certain neural pathways. To these we give the names *reflex* and *instinct*. Some authors would include also certain more general tendencies, such as play. It is very likely that so-called random movements, like the kicking and squirming of an infant, should also be classed as innate.

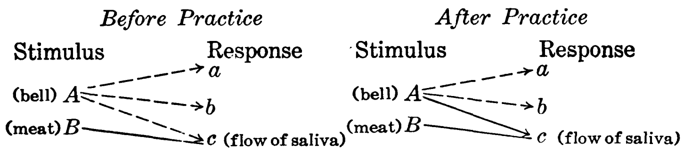

FIG. 18. THE MECHANISM OF THE CONDITIONED RESPONSE

The dotted lines represent potential connections; the solid lines, actual connections. At the beginning of the experiment there is a connection between the sight of the meat and the flow of saliva. There is no connection between the bell and the flow of saliva. The ringing of the bell has a number of potential relationships. The sight of the meat and the simultaneous ringing of the bell fix the connection A→c rather than the other possibilities. After practice either the ringing of the bell or the presentation of the meat will cause the flow of saliva.

One of the chief differences between reflexes and instincts is in the ease with which they can be modified as the result of training or experience. Reflexes are modified only by extensive training. In fact some reflexes, such as the pupillary reflex, are almost impossible of modification. Others, such as coughing, are much more subject to training.

Let us now consider how these modifications take place. While examples of this process are common, the experimental study of how it takes place was first made by the Russian psychologist Pavlov not many years ago. In this experiment, Pavlov presented a dog with a piece of meat. At the time the meat was presented, a bell was rung. A fistula had been constructed in the dog's cheek through which the saliva from one of the salivary glands was conducted to a counting device for recording the rate of flow. It was found that the rate of flow was greatly increased by presentation of the meat. At the beginning of the experiment, the ringing of the bell alone produced no increase of flow. After the meat and the bell had been presented together several times, the bell was rung without presenting the meat. Immediately the saliva began to flow as it had when the two were presented together. Thus a stimulus originally ineffective, through association with a stimulus which is effective, may be made to produce a response.

This type of simple learning is illustrated diagrammatically in Figure 18. By this means, stimulus A becomes connected through association with the B→c reflex and results in the A→c response. The only other assumption that we need to make in this explanation is that the nervous impulse from the substitute stimulus is drained into the B→c channel. Practice fixes this connection. The result of this fixation is what is called a *conditioned response.*

Such processes, with some complications, form the basis of all learning. These complications will be further explained in the chapter on learning.

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CHAPTER III

INNATE BEHAVIOR

X. TYPES OF INNATE BEHAVIOR AND THEIR SIGNIFICANCE

Stated in the order of their increasing complexity, the forms of innate behavior are tropisms, reflexes, and instincts. Concerning each of these we wish to know their form, to what extent they are uniform in their operation, to what extent each may be modified, and how this knowledge may be used to increase our efficiency and to increase the harmony of our relations with others.

Meaning of Innate Behavior. When the individual organism is born, its morphological structure is such that certain types of behavior are quite likely to occur. In some instances these behavior patterns are so fundamental biologically that if they do not take place the individual will die. Examples of these are the functioning of the lungs, of the circulatory system, and of the stomach and intestines. Even these acts require certain environmental situations in order that they may operate, but we can expect enough uniformity in the environment to permit their functioning. One cannot breathe without air, but we are never born into a vacuum. When we speak of innate behavior, we do not mean behavior which is independent of the environment, but behavior the largest component of which is the morphological structure of the organism.

There are very many types of behavior which, though not absolutely essential for the life of the organism, are more likely to occur than not. A man does not have to walk in order to live, but he is more likely to walk than to lie on his back throughout his life. A sparrow and a duck can both walk but, when provided with the right environment, the sparrow is more likely to fly and the duck to swim than they are to confine their movements to walking.

When we see an adult human being doing a specific act, it is very difficult to know just what proportion of that act depends upon innate morphological structure and what proportion depends upon the influence of environmental situations. Such knowledge would be very valuable to us for, were an act entirely dependent upon innate factors, its occurrence would be invariable and inevitable and we should have a sure means of controlling and predicting behavior in that one particular.

Criteria of Innate Behavior. In spite of the fact that we cannot tell with absolute certainty the extent to which an act is innate, there are some criteria we can apply which will give us a rough approximation of the part played by innate factors. The three of these criteria most widely accepted are universality, unlearnedness, and appearance soon after birth.

1. *Universality.* If an act of conduct is common to all members of a species, this fact argues the innate nature of the conduct. There certainly is a universality in eating, for all organisms eat. We can say there is an innate component in eating. But universality in itself does not prove innateness. It must be shown that there is no uniform environmental element which might account for the universality.

2. *Unlearnedness.* If on the very first occasion that a behavior pattern is permitted to function, it operates in a very definite way, we have evidence that the pattern is innate. The pupillary reflex in the human being is an example of this. In a newborn baby the pupil will contract when stimulated by a bright light. This response continues practically unmodified throughout life.

3. *Appearance soon after birth.* The fact that an act is

present at birth or soon after birth is good evidence that the act is innate. However, an act depends upon the maturity of the organisms involved. Since some organs do not mature until sometime after birth, it is conceivable that the factors determining this maturation may have been present at birth but the act could not appear until the effect of such maturation became apparent. In such a case the resultant act has a greater chance to appear in greatly modified form than were it to take place immediately at birth. This is true particularly of the sexual behavior of organisms. The sex organs do not mature until after a period of infancy, and sex conduct awaits such maturation. But throughout infancy certain types of training may affect the individual so that when sex activity does appear it is quite different from what it would have been had there been no learning.

It is apparent that none of these three criteria can be applied independently, and it is also apparent that, even when all three are applied as rigidly as possible, our answer to the question as to what part of adult behavior is dependent upon innate factors is a relative one. There is a large innate element in the fact that a man eats, but the fact that he eats with his fork is determined largely by training. There is a large innate element in our sex lives, but the manner of a man's wooing depends upon the training he has received even before the maturation of his sex glands.

Advantages and Disadvantages of Innate Behavior. The great advantage of innate behavior is that it enables us to do things which are important for our welfare without going through the process of learning. Furthermore, where uniformity of conduct is essential, we avoid the possibility of making serious blunders if our conduct is determined for us.

The great disadvantage is that we must do things in a specific manner even though it means our ruin. An illustration of this is the activity of the moth fly. This insect tends to fly toward a bright light. It does so even though such conduct may mean its death. The disadvantages of innate, unmodifiable behavior are evident from the great numbers of dead moths that lie about an arc light on a summer's night.

One who studies psychology for the purpose of learning laws of human conduct so that he can control his fellows might wish that human psychology were as simple as that of the insect, but he will not find it so. The proportion of unmodifiable and uniform conduct in man is rather small and this is one of the facts that the student must recognize. We need not fear that another may study enough psychology to gain easy control over our behavior. We have the possibility of learning a new mode of conduct while he is learning how to control our former conduct. While one nation is learning to build airplanes to bomb its enemies, the enemy is perfecting an airplane destroyer. One nation invents poison gas, but its enemy forthwith produces a gas mask. The salesman is learning how to sell me merchandise that I do not want, but I retaliate by learning how to analyze his technique and buy only what I want. The foreman learns methods of obtaining loyalty and more work from me, but I can study the methods whereby I may induce my foreman to advance me. Man has a hard time learning to adjust to his environment because he is born with so few fixed behavior patterns; but this fact makes possible so many varied reactions that he does not perish in hordes as do animals that are enticed by such devices as arc lights, fly paper, and mouse traps. To be sure, the Trojans were fooled by a wooden horse, but there has been only one successful wooden horse.

In short, the longer the period of infancy, the greater the chance of making intelligent responses to the environment. Long infancy means few fixed patterns at birth; it means that some very simple acts have to be learned.

Forms of Innate Behavior Patterns. The living organism is in a state of continued action from birth to death. Life involves activity. An organism so simple in structure that it possesses no specialized sense organs, only a very crude muscular system, and no nervous system, is continually busy adjusting as best it can to its environment. Even the simplest organism receives stimuli and reacts to them. The simplest reactions of lower organisms are called *tropisms*. As a nervous system develops, conduct becomes complex in proportion to the complexity of the nervous system. Furthermore, with the development of the nervous system we find a corresponding development of intricate receiving organs and an elaboration of muscles and glands. The simplest form of reaction involving a nervous system is called a *reflex*. Reflexes are for the most part innate. Complex forms of behavior with a large innate component are called *instincts*. We shall take up these various forms of innate behavior in turn.

XI. Tropisms

A complex process becomes clearer when it is analyzed into its simplest components. First we shall study tropisms, the simplest form of reaction that we find in organisms. These are classified according to the stimuli giving rise to them.

Definition of Tropism. A tropism may be defined as that determining tendency which exerts a directive effect upon the movements of an organism causing it to go toward or away from the source of stimulation.

Loeb claims that tropisms are identical in plants and animals.

The explanation of them depends, first, upon specific irritability of certain elements of body surface, and secondly, upon the relation of symmetry of the body. Symmetrical elements at the surface of the body have the same irritability; unsymmetrical elements have a different irritability. Those nearer the oral pole possess an irritability greater than that of those near the aboral pole. These circumstances force an animal to orient itself in such a way that symmetrical points on the surface of the body are stimulated equally.[1]

Some observers think that they can trace evidences in the human organism of a type of activity which is very prominent in lower organisms. First, let us examine some of the tropistic tendencies clearly evident in lower forms of life and then evaluate the primitive behavior of the infant in the light of the facts derived from our investigation.

Certain creatures always move toward the light; others seek out the dark places. They do this in a purely mechanical fashion. The moth attracted to the lighted candle may be de-

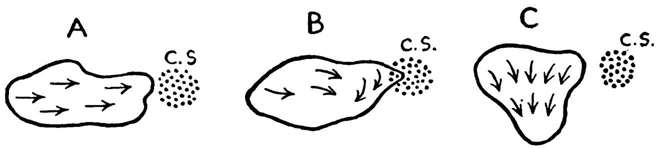

FIG. 19. POSITIVE AND NEGATIVE CHEMOTROPISM IN AN AMŒBA

(A) Amœba attracted to a chemical substance (C.S.), (B) Contact, (C) Withdrawal.

stroyed by the flame. As a caterpillar, it will climb toward the top of the tree where the light is brightest and where there are tender leaves for food. In the first instance this tendency resulted in the destruction of the organism. In the second instance it proved to have a biological value. The positive and negative possibilities of these determining tendencies are evident wherever they are found.

Chemotropism. Chemotropism is a tendency to move toward or away from chemicals that act as stimuli. This is a rather common type of tropism. Amœbæ react negatively to most chemicals, but positive chemotropism is held by some authorities to play a rôle in the food taking of amœbæ. The

[1] Holmes, S. J., *Evolution of Animal Intelligence*, p. 20. Holt, 1911.

tropistic activity of an amœba to chemicals is illustrated in Figure 19.

Geotropism. The movements of some organisms are directly affected by gravity. Such a response to gravity is called *geotropism.* It has been observed by Massart, according to Holmes,[1] that "the sense of geotropistic responses varies in allied species of the same genus as, for instance, spirillum, some of which are positive and some negative under the same conditions." In more highly developed organisms, especially in vertebrates, there is a tendency to maintain a definite orien-

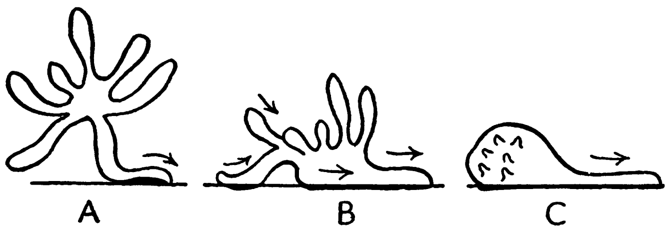

FIG. 20. POSITIVE THIGMOTROPISM IN AN AMŒBA

tation. This is facilitated by neural connections between the semicircular canals of the inner ear (see page 130) and the skeletal musculature involved in the maintenance of bodily position.

Thigmotropism. Response to solid objects is called *thigmotropism.* Contact with solid objects is an important phase of the life of many organisms. The adaptive capacity which enables them to react to contact effectively furthers their life history. Food, shelter, and the avoidance of hostile environmental factors are secured in this way. Amœbæ show positive thigmotropistic tendencies. Reactions of this sort are illustrated in Figure 20. Many marine organisms of higher types possess the same characteristic. Oysters cluster on the sea bottom, forming huge beds.

[1] Holmes, S. J., *Evolution of Animal Intelligence,* p. 29. Holt, 1911.

Phototropism. Phototropism is the tendency of organisms to react to light. Larvae, for the most part, are positively phototropic during the early stages of their development. Later on, they react negatively to light.

Thermotropism. Most animals react not only to light but also to heat. Such reactions are called *thermotropisms.*

Characteristics of Tropisms. The most important characteristics of tropisms may be summed up as follows:

1. Tropisms do not necessarily depend upon the presence of a nervous system. Organisms such as protozoa are affected by them more generally than other creatures.
2. Tropisms involve the activity of the organism as a whole.
3. According to Loeb, they depend upon physio-chemical relationships between the organism and the environment.

In organisms possessing specialized structures for sensing and reacting, the tropistic tendencies are apparently overlaid with more specific forms of behavior. If, in any true sense, they are present at all in higher forms of life, they lack much of their fixity. An infant may turn its eyes towards a light, but an adult may turn his eyes away, according to the needs of the situation. The adult may seek the support of the back of his chair because he is tired, or he may go to a table near the wall in a restaurant because he has previously arranged to meet a friend at that particular spot, rather than because of any thigmotropistic tendency. It is thought that positive chemotropism accounts for the fact that bacteria attack certain tissues of the body. The same type of tendency may cause the male sperm to seek the ovum, but the distinction should be made that in the last two cases, it is the bacteria and the spermatozoa which show tropistic tendencies, and not the human organism itself.

The difficulties which arise in seeking to determine the extent to which the higher organisms are affected by tropistic tendencies are apparent. The tremendous complexity of the structure of man, his greater range of capacity for adjustment, as well as the extended range of stimuli to which he may respond, make it hazardous to assign specific causes for his actions. Suffice it to say that, if present at all, tropisms, as such, play only a minor rôle in the adjustments to life made by the human organism.

XII. Reflex Action

With the development of specialized tissues, such as sense organs, muscles, and nerves, it is possible to identify behavior in more specific terms. A reflex is the name given to an arrangement of specialized cells which includes sensory and motor components. It is the functional unit of the nervous system and represents the simplest mechanism for a receptor-adjustor process.

The Simple Reflex. The simple reflex consists of a sense organ irritable to a specific type of stimulation, (light wave, sound wave, etc.), a sensory nerve which proceeds toward a nerve center, and a motor fiber which conducts the nerve impulse to a muscle or a gland. Some writers have called it a short reflex because it involves but one neural connection and the circuit from sense organ to muscle can be completed in a few hundredths of a second. While it is not always the case, more often than not the motor impulse distributes to a muscle near the sense organ which was stimulated. For instance, a strong light suddenly flashed in the eye causes the pupillary opening to become smaller. The sensory impulse going into a center sends a motor impulse back to the muscles which control the opening through which the light stimulus passed.

On the next page is a classified list of some common human reflexes.

1. Present at birth — Little modified by training:

Reflexes involved in:

breathing	hiccoughing
digestion	attack
circulation	withdrawal
sleeping	trembling
sneezing	snoring

2. Present at birth — Largely modified by training:

Reflexes involved in:

food-getting	grasping
crying	evacuation
winking	micturition
accommodation	fighting

3. Not observed at birth — Appearing later in life:

Reflexes involved in body posture:

holding head erect
sitting
standing
balancing

Reflexes involved in sex activity
Vasomotor changes (blushing, paling, etc.)
Reflexes involved in walking

Compound Reflexes. The compound reflex involves a more complicated pattern. There is an elaboration which may occur on the sensory side or the motor side of the arc, or within the connecting neurones. It may be that two or more sensory impulses distribute eventually to a single motor tract involving a reaction of a very small area of muscle tissue. On the other hand, a sensory impulse may become elaborated by means of connecting fibers into a very diffuse motor pattern. It is well to remember that compound reflexes almost always involve connections at more than one level in the cord as well as centers in the brain stem. (See Figures 15, 16, and 17.) Sucking, grasping, standing, and balancing, as well as the action of the organs of digestion and reproduction, are examples of compound reflexes.

The Chain Reflex. A chain reflex consists of a series of smaller reflex units arranged in such a way that each unit, as it completes its function, acts as a stimulus to its immediate neighbor, inciting it to action. Swallowing is a good example of this type. This act consists of a series of constrictions of the esophagus. The movement proceeds downward, each ring of muscle as it contracts acting on the one below it as a stimulus to action.

Circular Reflexes. Circular reflexes are a special type of chain reflex. The main difference is in their organization. The sensory impulse (kinesthetic largely) developing from the preceding muscular activity, passes back to the center in the cord or brain and then out again over the same motor pathway. This type of activity tends to maintain continuous action of the same mechanism. On the physiological level the continued beating of the heart, the maintenance of the grasp one has of an object, and the prolonged tonicity of a muscle are examples of this reflex action. On the level of acquired behavior, speech develops out of a similar circular mechanism.

Elaboration of Reflex Activity. The more complicated types of behavior which result from these elaborations may be influenced by the *strength* or *spread of the stimulus.* A sharp prick of a pin may bring about a more marked response than slight contact. A large area of the hand stimulated simultaneously or a beam of light flooding the eye tend to produce more complete responses than the same type of stimulation would produce if restricted to smaller areas. In the first case, the cause for reaction was an intense but narrowly localized stimulus, while in the latter illustrations the cause was a stimulus pattern of great extent.

When elaboration occurs in the motor constituents of the reflex arc, marked differences in behavior result. A drop of liquid in the throat starts the elaborate swallowing mechanism. Food in the stomach starts the complicated processes of digestion. When one strikes his finger with a hammer, very elaborate patterns of response are often evoked.

Compound reflexes have been further classified in two ways. They may be thought of in terms of their functional relationships to each other or in terms of their particular structural arrangements. In the first instance, the reflexes are described as antagonistic or allied. The *antagonistic reflexes* are those which involve muscles producing quite opposite types of behavior. For instance, we may open or close our hand, extend or bend our fingers, but we cannot do both of these things at once. The action involved in extension of the fingers is the opposite of that involved in bending them. *Allied reflexes* are those which function in such a way that they mutually reenforce each other in their effect on the reacting mechanism. For example, a dog, starting to scratch itself, shifts its balance on three legs. A runner, set to start when the pistol is fired, has many reflexes allied to give him the greatest release of energy possible when the stimulus is given.

Characteristics of Reflex Action. The characteristics of reflex activity may be summarized as follows:

1. *Reflexes are relatively fixed modes of behavior.* It was noted at the beginning of this chapter that the organism starts out in life with some mechanisms already active and effective. It is supposed that these mechanisms form the nucleus around which all the learned behavior develops. Because they are biologically useful, it is well that they are not easily modified. Swallowing and sucking, breathing and sleeping are necessary functions of the human organism if it is to survive. Many other reflex mechanisms are just as important. They play their rôle in the maintenance of life and the furtherance of the bio-

logical welfare of the organism. Sneezing eliminates objects from the nasal cavity which may be detrimental to the organism. The pupillary reflex protects the retina from too intense stimulation. The activity of the heart, the circulation of the blood, and the activity of the stomach all depend on regular and constant reflex functioning. Variation in action might mean injury or death.

These fixed mechanisms with which we are born are usually the ones most likely to function continuously until death. They are essential to the maintenance of a purely biological existence. Consequently, senility may be far advanced, much that the organism has learned may have been forgotten, acquired skills may be long since lost; yet these reflex mechanisms function on, keeping the organism alive.

2. *Reflexes are not under the organism's control.* Suppose it were necessary to direct, by means of attentive control, the functioning of the viscera during the reception and digestion of food. Suppose one had to attend in order to keep his heart beating or his breathing normal. What a difficult time he would have! There would be little or no opportunity for him to learn anything. He would scarcely be able to acquire those new adjustments for which the guidance of attention is so essential. The very fact that most reflex action goes on without the direction or control of the individual guarantees that, under normal organic and environmental conditions, each reflex mechanism will be active when stimulated and complete its functioning in accordance with its general make-up. However, there are certain reflexes, not directly connected with the intra-organic life of the organism, which undergo modification during the life history of the individual. The intensely strong grasp of the newborn infant gradually disappears, and there is evidence, though not conclusive, that the knee-jerk reflex is reduced when other reflex mechanisms are simultaneously activated.

3. *Reflexes constitute an organic response, unitary in character.* Biologically the organism is put together in such a way that it tends to act as a whole. The integrative action of the nervous system makes this possible. The organism itself is more than a compounding of parts. It is an integrated whole. The fertilized ovum is a unit which becomes progressively differentiated as it develops. The nervous system, as such, is a part of that differentiation. Consequently, each structure, each part of the organism, is related to the whole, both structurally and functionally. Each reflex pattern is not an isolated mechanism, absolutely independent of every other part of the organism; yet it possesses the capacity to act in relative isolation when the need arises. The fact that in any really complicated form of behavior both innate reflexes and learned responses make up the unit indicates the relation which always exists between all parts of the organism. While it may be easier to think of behavior as a combination of many reflex arcs, and while an analysis of any behavior pattern may enable us to isolate the factors which played a part in it, it must be remembered that fundamentally the organism acts as a whole, maintaining its unity and wholeness in relation to its environment. The rôle of the fixed mechanisms becomes clear when seen in this light. They are the basic constituents without which adaptive behavior would be impossible.

Innate Responses of Infants. Those interested in the problem of the innate responses of the human infant owe a great debt to John B. Watson [1] for his pioneer work in this field. Later workers such as Mrs. M. G. Blanton [2] and the Shermans [3] have also made further significant contributions. Upon the

[1] Watson, J. B., and Watson, R. R., " Studies in Infant Psychology." *Scientific Monthly,* 1921, Vol. 13, pp. 497 ff.

[2] Blanton, M. G., " Behavior of the Human Infant During the First Thirty Days." *Psychological Review,* Vol. 24, pp. 456 ff.

[3] Sherman, Mandel, and Sherman, Irene Case, *The Process of Human Behavior.* W. W. Norton and Co., Inc., 1929.

basis of her study Mrs. Blanton lists the following forms of behavior as unlearned:

1. *Sneezing.* Sneezing is often present at birth, even before the birth cry itself. The stimulus which elicits this response is not well defined. It is a type of activity which persists throughout the life of the individual.

2. *Hiccoughing.* This act usually does not appear until several days after birth, but it has been observed earlier. The stimulus which produces this response is thought to be the pressure on the diaphragm due to a full stomach. As an activity it may occur at any time during the life history of the individual.

3. *Crying.* This activity is present at birth as the birth cry. It quickly becomes conditioned by widely different types of stimuli.

4. *Eliminatory functions.* Urination and defecation are activities possible and often present at birth. At least they become an essential part of the mechanism of the child at a very early age.

5. *Orientation activities.* The movement of the eyes as they follow a bright light or the movements of head and eyes which occur when an infant is placed on its stomach are examples of orientation activities. Such behavior is observed directly after birth.

6. *Gross body movements.* These include the random movements of arms and legs, grasping, the upward movement of the great toe and the downward movements of the others (known as the Babinski reflex), kicking, and turning the body from a prone to a supine position. Most of the activities appear at birth or soon after. The grasping reflex loses its potency very quickly and the Babinski reflex usually disappears within a year.

7. *Food-getting activities.* The sucking reflex, accompanied by an orientation of the head toward the source of stimulation,

is observed in infants not five hours old. Sometimes, however, this behavior does not appear till later.

8. *Walking.* This complex pattern, involving as it does many sensori-motor arcs, may be considered unlearned in its primitive form. It is, as Watson says, a slowly developing co-ordination depending for the most part upon the maturation of the child.

9. *Smiling.* This activity appears as early as the fourth day and at that time seems to be due to the presence of kinesthetic and tactual stimuli. It persists throughout life and as a result of conditioning may be elicited by many other stimuli than those mentioned.

10. *Sex activity.* Beginning with the susceptibility of the erectile tissue to irritation, which appears at birth, the whole pattern of sex behavior evolves as the maturation of the individual progresses. That the response is subject to some modification through conditioning processes is well known.

11. *Fear reactions.* Watson observed that a loud noise and loss of support produced a pattern of reactions involving "a jump, a start, a respiratory pause followed by more rapid breathing with marked vasomotor changes, sudden closure of the eyes, clutching of the hand, and puckering of the lips. After this occurs — depending upon the age of the infant — crying, falling down, walking, or running away."

12. *Rage reactions.* These responses are produced in very young infants by hampering their body movements. Phases of the pattern of this response are stiffening of the body, free slashing movements of the arms and legs, and holding of the breath.

13. *Love reactions.* The stimuli effective in eliciting these responses are stroking the skin, tickling, gentle rocking, and patting. The pattern of the response involves smiling, gurgling, and cooing, and later in development, laughter.

Mrs. Blanton's findings relating to these last three types of unlearned behavior have been questioned by Sherman and others. It is possible that refinements in experimental technique and a greater number of observations may result in certain modifications of her results.

This list of the innate responses of infants is not classified according to reflexes and instincts. We may state that those given in the first part of the list are generally called reflexes and those in the latter part, instincts. This leads us to the problem of the difference between these two forms of innate behavior.

XIII. Instinctive Behavior

In this section we shall study those forms of behavior which, although relatively complex, nevertheless depend largely upon innate behavior patterns. We shall find it instructive to compare the instinctive behavior of animals with that of man and finally to study the manner in which these instincts build themselves into more complex behavior patterns.

Instinctive Behavior in Lower Forms of Life. One of the most striking facts which presents itself to the observer of the simpler organisms is the relative fixity of their adjustments. Among insects, for example, we find very elaborate types of behavior, such as cocoon building, the construction of other types of protective dwellings, the making of provisions for their young, and the like. Ants may be observed in very complex social behavior which is apparently unlearned. They have a remarkable division of labor within the colony and show definite variations in structure to correspond to their differential functioning in the social order. A wasp builds her mud nest, lays her eggs, and dies without any knowledge of the end involved. The bird builds her nest according to its type. The salmon leaves the ocean deeps to swim against a river current to its head waters, there to spawn and die. There is very little modifiability in this behavior, and little or no opportunity for learning.

If we observe organisms slightly higher in the biological scale, we find a tendency toward a greater plasticity and variability in their behavior, although the basic pattern of adjustment is present. Such studies as those made by Spalding on the ability of birds to fly, by Yerkes on the mice-killing proclivities of young kittens, and by Breed and Shepard on the pecking activities of young chicks, indicate the presence in all of these animals of a tendency toward that specific type of activity studied. The significant fact is that the exercise of the tendency usually resulted in a perfecting of the act; the birds flew better after practice; the chick pecked more accurately and selectively after it had had experience in pecking.

Upon observing the large-brained vertebrates, we find that as the higher centers become enlarged and differentiated, a greater spontaneity and variety in behavior results. Instead of a fixed behavior pattern, we find a greater range of variation within the activity itself. Instincts become less specific in character and more generalized in their appearance. Consequently, they are harder to identify.

Characteristics of Instincts in Man. The study of the instinctive activity of man has been for many years handicapped by the assumption that man has all the instincts that animals possess. It was the custom to observe the instinctive behavior of animals and then to infer that man had the same unlearned tendencies. Recent observation of human infants has dispelled these illusions, and we now know that the human infant has relatively few unlearned behavior patterns and that the few which he does have form a very minor part in the extended elaboration of behavior which man's greater complexity and plasticity of structure permit.

1. *Instincts in man are not clearly defined.* The tendencies toward a definite type of behavior which can be definitely de-

termined are ill defined in man. Because of his tremendous adaptability, his great power of learning, any complex instinctive pattern is soon overlaid and modified. As an infant, he is helpless. For years he is incapable of making his own way in the world. He is cared for, fed, clothed, and nurtured by loving care and tenderness, with the result that by the time he is in a position to exert himself and make his own way, man has taken on the coloring of his environment. He speaks a particular language, has adopted customs and habits of thought and conduct common to his group, and in many ways has so modified instinctive behavior that its only distinguishing mark is the urge or tendency to act in a certain way. He may have the urge to eat, but the particular way in which his eating is done or the particular food that he eats is a matter of the custom and convention of his group. He may have the instinctive urge to reproduce, but the love-making and home-building preliminary to mating will be determined by local custom and environmental needs. As a child he will naturally or instinctively play, but the characteristic games and methods will be different in different countries and societies.

2. *Instincts as an expression of a biological urge.* All the so-called instinctive activity of man rests upon his basic urge to action. As long as an organism has life, it tends to act in some manner or other. When some circumstance in its environment threatens to destroy its integrity as an organism, its activity is increased. Some situations or stimuli in the environment accentuate this tendency to action while others tend to restrain it. In infancy we respond to these harmful situations by vague activities but we soon make our behavior specific as we learn which reactions tend to remove the noxious conditions. The life story of man is largely the account of his change from an inefficient and foolishly behaved child to an adult who responds efficiently and intelligently to his environment. We can assume that the biological urge is behind all

conduct, but it is a thing to be taken for granted rather than used to explain specific behavior.

3. *Instincts are modified by social demands.* Whether the biological urge to activity is still in its undifferentiated form or whether it has become specific, it is continually running counter to social and environmental restrictions. Conduct is a compromise between our inner urges and social restraints. We want to eat; but we cannot steal our food, eat it with our hands, or spill it over our bodies and at the same time gain the approval of our comrades. We gratify our impulse to eat but we do it by earning our food and eating it in the approved fashion. A pig makes no compromise with society; he eats unrestrainedly to gratify himself.

When some urge cannot get a direct expression, it may manifest itself in some indirect form. This is called *sublimation.* A woman, being denied a family, may gain satisfaction in teaching school, adopting a child, nursing, managing an orphanage, or even in mothering a cat or dog. The interest many persons show in their chosen work often depends upon such a situation. They make good workers so long as the work continues to be an outlet for an otherwise ungratified urge, but let the urge be gratified and the interest in the work vanishes. A woman devoted to child welfare work in a certain community suddenly lost all interest when she became a mother. One who has to deal with people should understand this principle in all its subtle forms.

An instance of an instinctive tendency conflicting with social inhibitions is seen in the case of a little boy who is frightened by a dog. He wants to cry and run but he dare not do so for fear of the taunts of his comrades. His instinctive fear may win and he may run; social pressure may win and he may chase the dog; or he may make some sort of compensatory adjustment. Examples of the last form of reaction would be: the boy tries to sick the dog on another boy in order to get rid of him;

he accuses another boy of being afraid in the hope that this boy will chase the dog to show his bravery; or he secretly poisons the dog in order to prevent any meeting with him.

Classification of Instinctive Responses. All conduct may be said to spring from one general tendency to be continuously active and it is possible to classify the forms in which this tendency expresses itself. Classification of these forms, however, is merely descriptive of behavior observed from an external point of view and does not presuppose any specific types of urge to correspond. It includes (1) acts which tend to preserve one's own life, (2) acts which tend to preserve the race, (3) acts which intensify egotic experience, and (4) acts which facilitate social survival.

1. *Those which facilitate survival.* The seeking and accepting reactions, resistance, including rejection or withdrawal, as well as struggling and fighting, and perhaps the play reactions (although this is questionable) are instinctive tendencies of this group. The newborn infant shows "starting" behavior when support is removed, when loud sounds are suddenly introduced, or when it is immersed in water. Within two or three days after birth, definite withdrawing responses are elicited by nocuous stimuli and by intense tactual stimulation on the feet or hands. If a baby's hands are held or its limbs restrained, thereby making the usual random movements impossible, there usually follows definite struggling behavior. Apparently the elaboration of this primitive resistance constitutes the fighting reactions of the more mature child.

As these reactions appear in infants, there can be no knowledge of the end involved, but they represent very necessary forms of behavior for the preservation of the individual from a biological point of view.

2. *Those which facilitate racial survival.* In this group of tendencies we have those which depend upon the maturation of the individual for their physical basis. To a certain extent

they are subject to the conditioning influences of custom, convention, and the mores of the group.

The urge to mate is common to all species. In human beings this tendency gradually becomes dominant as adolescence passes into early maturity with the accompanying maturation of those intro-organic functions upon which the act of mating depends for its essential fulfillment. Courting and love-making, which are preliminary to the mating itself, take on the coloring of the social custom of the group.

Parental love and care for the young, and the love responses for the offspring, develop biologically with the tendency, as evolution of higher forms advances, toward prolonged infancy and helplessness of the young. Racial continuity, as well as immediate social organization, depends upon them.

3. *Those which intensify egotic experience.* The child gradually senses his individuality, and much of his behavior is an expression of his instinctive tendencies to intensify this experience of selfhood or individuality. Acquiring things or collecting objects of no value except to the child who acquires or collects them illustrates the phenomenon. The child, under normal conditions, seeks egotic expression. The dominant person is egotic and has positive affective experience from his supremacy. The man collects and builds and creates primarily because of his instinctive desire to further his egotic expression. A very important aspect of human behavior is found here. John Dewey suggests that it is better to say that the real proof of existence is, "I possess; therefore I am." Even the most apparent altruism has its real foundation in egotic desire and the individual tendency to achieve self-expression. If you wish to make and keep a friend, never do anything to lower his self-esteem.

4. *Those which facilitate social survival.* Man cannot and does not live alone. Throughout the long evolutionary development of living things, the tendency toward the main-

tenance of group relationship becomes more and more evident as the highest level of development is attained. The protective reactions of parents, the filial relationships of children to parents, the broader tendencies toward social sympathy and conformity are present in all men. They form the basis for social continuity and social relationships, as well as the battle ground for all personality conflicts. To satisfy the urge toward self-expression and to maintain at the same time the adequate satisfaction of social needs is not easy. The struggle for survival in an earlier day may have been primarily biological even on the human level. It is rapidly becoming a social one.

The Integration of Instinctive Tendencies. Anyone who analyzes his own life history or who observes carefully the lives of those about him soon comes to realize that in normal conditions these instinctive tendencies form the basis for a satisfactory development of individual personality and social continuity. The most highly developed human being is one whose behavior gives evidence of an adequate balancing of these tendencies. Normality consists in the maintenance of satisfactory adjustment between the organism and the environment. The biological, egotic, and social drives of the individual are expressed in behavior in terms of environmental demands and immediate needs. Environmental demands which inhibit adequate expression of instinctive tendencies cause repression on the part of the individual. From the point of view of developing a balanced personality, this may be dangerous or disastrous. But on the other hand, overexpression of instinctive tendencies may become socially undesirable and create as a result a social problem.

The urge to eat, to make love, to reproduce, to accumulate material goods, to be with one's own kind are not found in isolation but in combination. The balancing of these tendencies into an integrated program of behavior is facilitated by the intelligence with which a man discovers himself and acquires a mastery over his environment.

Random Movements. There is another type of behavior which may well be classed as innate. The small child kicks, squirms, waves his hands, gurgles, coos, and makes other types of responses. Such responses seem to be due to stimulation from clothing, digestion, and possibly, as some have suggested, from the semicircular canals.

The chief difference between this type of behavior and the others we have described is the unpredictability of the form of the response. In reflexes we are able to predict with little error the type of response which will be made to a certain form of stimulus. In instincts the form, as well as the complexity, is more variable, yet it is predictable within limits.

On the other hand if we watch a baby awake in his crib, we are almost completely at a loss to predict what he will do next. He is continually active, but first he is doing one thing and then something else. Such behavior is also present in adults, but here it is more or less complicated with many forms of learned responses.

The explanation seems to be that the balance for the different pathways in the nervous system is almost equal but variable. First one pathway is most permeable; then, because of fatigue or some other reason, another pathway becomes more permeable. As a result of such shifts the form of activity is also characteristically variable. If we knew all the factors involved, no doubt we should have an explanation for the shifts. Since we do not, we call such activity *random movements*. They are random only in the sense that we do not know the causes for their variability.

Instead of being insignificant and unimportant such random movements, as we shall see in a later chapter (Chapter VII), become the basis for many of our skilled acts. Man's variability of response is due to his wide range of unlearned behavior.

The Significance of Unlearned Behavior. The way in which these innate forms of behavior become elaborated into modern life is a problem for the latter half of this text. Suffice it here to point out that it is upon the basis of this innate behavior that all learning is superimposed. If native forms of response do not meet the needs of the individual, such forms are modified and other more efficient forms are discovered. The complexity of these modifications runs the gamut from the simplest responses of bacteria and other single-celled plants and animals to the most complex economical and social responses of man. Yet this basis, as we have just stated, is innate; furthermore, as has been indicated here and as we shall see in a later chapter, the drives for more adequate adjustments are fundamentally innate. Dashiell and others have shown that these are largely due to tissue needs of the body.

It may seem a far cry from the instinctive need for food to the elaborate economic institutions and methods of modern society. Nevertheless, for an adequate understanding of these forms of adjustment, we must look to the innate drives of man.

Much of the older psychology and much modern economic theory is constructed on the false assumption that many sorts of complex forms of behavior are expressions of instincts. These, it is believed, explain the complicated forms of modern social organization. Modern psychology has discovered that such explanations are only names and not explanations. If we are to understand such complex forms of behavior, they must be resolved into their elemental sources.

Food-getting tendencies and other human drives have become most complex in form and function. Modern home-life is an elaboration of several innate tendencies but undoubtedly sex is the strongest of these. Political life is so complex that it is next to impossible to analyze it. Elements present in it are food drives that bring people together, the drives back of home-organization that help in the formulation of social relationships, and other such varied needs as temperature, thirst, and the desire to be with others of the same type or race, if the last be innate. To these must be added the whole list of innate tendencies which we call emotional. (See Chapter XI.)

Under the stress of emotional experience and in situations where the environmental stimuli become excessive, the individual tends to react along his most innate and most fixed pathways. Under conditions that the individual recognizes as threatening his survival, the most fixed habit is not so likely to function as are reflexes and instinctive behavior. When learned modes of behavior are inadequate and experiment fails to produce a satisfactory new coördination, older pathways carry the burden of the adjustment. A knowledge of the nature and the strength of these instinctive tendencies enables one to select stimuli for their arousal and, by this means, to exercise some control over the behavior of others.

The advertiser tries to develop stimuli which will secure and hold the attention of people, knowing that this is the first prerequisite for further control of their behavior. After their attention has been gained, he may appeal to any one of the instinctive tendencies of man, depending upon his purpose or the end that he seeks. Propaganda for war, if properly directed and controlled, may by appealing to man's tendencies to resistance or protection create a positive emotional attitude. The salesman, knowing that one of man's fundamental desires is to possess, may manipulate stimuli in such a way as inevitably to call out this type of response. Or he may play upon the egotic tendencies as a whole and, by making the individual have an exaggerated sense of well-being and importance, secure his own ends through this means.

The executive dealing with men must recognize that there are differences among them due to individuality and to varying environmental conditioning, but that the same basic tendencies are operative in all men, although different tendencies may be dominant in each particular case. The man who effectively handles men knows how to play upon these instinctive tendencies and, by controlling the responses, gains the coöperation he seeks, and gets the work done.

Finally, in the development of quantitative measures for the selection of men for specific jobs, an application of the principle governing innate human behavior is essential. Men who have failed to develop adequate self-expression on account of unfavorable environment or unfortunate repression do not succeed in many types of business. It is essential, for instance in selling, that a man be socially dominant in his relationship with the buyers of his commodity. It is evident, then, that in any field where attempts are made either to select and control individuals for specific tasks or to influence in a general way the behavior of people, knowledge of the fundamental behavior mechanisms is necessary if success is to be assured.

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CHAPTER IV

SENSORY PROCESSES

XIV. The Function of Sense Organs in Human Adjustments

Since man's great task is to adjust to his environment, the development of specialized sense organs which enable him to interpret his environment has been of inestimable value. Some of these sense organs, being more highly specialized, are of greater value than others, and consequently deserve more study. Before studying the specific sensory processes, we shall take a perspective of the whole field of sensory activity.

Sensitivity without Specialization. One of the common characteristics of all living things is that they are sensitive to the external world. Indeed, sensitivity is one of the essential conditions of life, for if one could not receive any impression from the external world, he would not be able to respond or act in any manner. While the fact of sensitivity is apparent, the degree of sensitivity in different types of organisms varies tremendously, and these variations are, at least to a rough extent, correlated with the degree of specialization of the sensory apparatus to receive impressions from without the organism. Each organism lives in a sphere which is literally circumscribed by the capacity of its sensory mechanisms.

We can observe in the lowest forms of life responses to environmental situations even though no specialized receptor organs have been developed. It is this type of sensitivity which was described in the last chapter as giving rise to simple unlearned and undifferentiated reactions, called tropisms.

In animals a little higher in the biological scale we find the beginnings of sense organs. In some cases these are very crude and it is occasionally very difficult to discover the exact nature of the stimulus to which they are responding. Consider, for instance, the blindworm of England. This limbless lizard is commonly regarded as being unable to see, since its behavior shows that many of those visual stimuli which, falling upon man's retina produce visual impressions and evoke responses, leave it entirely unmoved. But let a little slimy, putty-colored slug, know as *Limax Agrestis,* appear on the scene, and there is an instantaneous response on the part of the blindworm. Something makes this animal sensitive to the presence of the *Limax Agrestis,* but this sensitivity is due to some capacity different from simple vision.

Specialized Sense Organs. In the higher animals we find very highly specialized sense organs, each sensitive to some different aspect of the external world and capable of translating this specific aspect into nerve currents which can become integrated with the rest of the animal's life. The animal develops specialized receptors in the skin that enable it to make better responses to objects with which it comes in contact. It develops taste buds that enable it to distinguish foods from poisons or inedible objects. It develops smell receptors which enable it to distinguish objects before they come in contact with the tongue.

In smell we have the simplest type of distance receptors or sense organs which receive impressions without coming into actual contact with the stimulating body. Highest in the scale of specialized sense organs are the distance receptors, the eye and the ear. Much of our superior development hinges on the development of these two distance receptors.

The development of specialized cells which became sensitive to various types of stimulating conditions took many forms. The eye, developing from the pigmented cells, assumed many differentiations according to the line of variation which marked its progress. Some eyes became specialized for visual acuity in decreased illumination; others became sensitive to microscopically small objects and differences; still others became especially efficient in long-distance or telescopic vision.

As we proceed upward on the animal scale, each sense organ appears in various stages of complexity, until we find in man a set of sense organs peculiarly adapted to his environmental needs. He does not have the microscopic eye of the fly, nor the sensitive smell organs of the dog, nor the highly sensitive ear of the deer. He is adapted to a middle range of sensitiveness. Being a free-moving animal, possessed of a superior brain and a creative capacity, man can extend the range of his sensitiveness as his needs for extension develop. He does this by creating instruments of precision to compensate for his inadequacies, as is exemplified in the invention of the microscope and the telescope.

Sensation as Part of a Reaction Process. Sensations should be regarded as one stage in the individual's process of adjustment, never as isolated incidents. A sound wave striking the ear is something to stimulate a reaction. If it has no significance for the individual, it may merely produce a vibration of the mechanism in his ear. It may be a danger signal, the voice of a friend, or a selection of beautiful music. Each of these is responded to in a different manner. How does it happen that we respond in this differential manner? This will be one of the objectives of our study. We shall first study the various sense devices and then, in later chapters, determine how the impressions come to have significance and to produce the various reactions which we find. We shall discover that a stimulus which, in the early stages of a child's life, produces an indifferent response may come to be elaborated to such an extent that the response is extremely complex and enduring.

In order to get a general perspective of the various sources

TABLE II. CLASSIFICATION OF STIMULI, RECEPTORS, AND SENSORY MODALITIES

(From Dashiell, *Fundamentals of Objective Psychology.* By permission of Houghton Mifflin Company.)

Stimuli	*Receptors*	*Sensitivity*
I. Energy changes in the environment	Exteroceptors *	
Light	in eye	visual
Sound	in ear (cochlea)	auditory
Heat (and cold)	in skin	cutaneous
Pressure	in skin	cutaneous
Chemicals	in nose	olfactory
Chemicals	in tongue	gustatory
II. Changes in position and movement of organism	Proprioceptors †	
Of parts Of whole	in muscles, tendons, joints, in ear (canals and vestibule)	kinesthetic static
III. General organic condition of alimentary canal and other viscera	Interoceptors ‡	
Emptiness or distension of a viscus, chemical substance, etc.	in linings of canal and other deep tissue	organic
IV. Conditions tending to do immediate injury	Nociceptors § in skin in nearly all important organs deep and superficial	pain

* Exteroceptor: a sense organ located on or in the surface of the body; irritable to external stimulation.

† Proprioceptor: a sense organ irritable to body movement.

‡ Interoceptor: a sense organ irritable to physiological changes within the body.

§ Nociceptor: a sense organ located in or on any part of the body which, when stimulated, gives sensitiveness to pain.

and types of incoming nervous currents, we have presented in Table II a classification of types of sensitivity and their stimuli.

XV. Visual Sensitivity

The eye is an apparatus, similar in principle to a camera, which transforms light waves into nervous currents. Having a very intricate task to perform, it is a very complex organ and, being very sensitive, it is equipped with various devices for adjustment and protection. It has mechanisms for enabling us to react differently to colors of various hues, brightness, and saturation, and for aiding us in learning spatial relations, such as areas, movement, and distance. On the other hand, it is poorly adapted for giving us an adequate conception of time relations. It is primarily a space receptor.

The Human Eye. The eye resembles a camera. It is essentially a dark chamber in the front of which is a tiny opening, the pupil. The pupil is adjustable in size through the operation of the iris, which corresponds to the diaphragm of the camera. When the illumination is poor, the pupil becomes larger; when the illumination is intense, the pupil becomes smaller. Behind the pupil is a lens which refracts the incoming rays of light and brings them to a focus on the retina, the sensitive part of the eye. In a camera adjustment to distance is made by changing the distance between the lens and the sensitive film. In the eye the distance between the lens and the retina is constant and adjustment to the distance of an object is made by a change in the thickness or curvature of the lens. The general similarity between the parts of the eye and the parts of a camera is illustrated in Figure 21.

Each eye, almost spherical in shape, is supported in its socket by three pairs of muscles. Controlled by these muscles, the eye can move, within limits, in any direction. Normally, visual experiences are based on the coördination of the images in both eyes and, in order to effect such harmony, the eyes move and adjust synchronously. The general arrangement of these muscles is shown in Figure 22.

The walls of the eye (see Figure 23) consist of three coats.

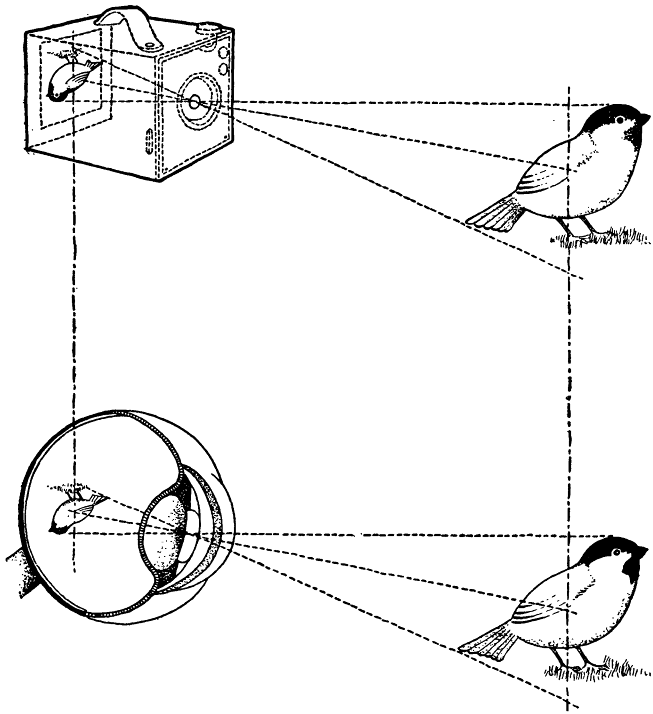

FIG. 21. COMPARISON OF THE PARTS OF THE EYE AND THE PARTS OF A CAMERA

(1) Outside is a tough fibrous coat, called the *sclerotic coat*. In the front part of the eye this coat is called the *cornea*. (2) The second coat, which is very dark, is called the *choroid coat*. The pigmented part of the eye known as the *iris* is the front section of the choroid coat. (3) The third and innermost

coat is the *retina*. This coat is the sensitive layer upon which the incoming light rays are focused and by means of which they are transformed into nervous currents to be transmitted to the brain. The retina is absent in front and covers only a little more than half of the back portion of the eye.

All of the media through which the light passes as it goes to the retina are transparent. Between the cornea and the crystalline lens the area is filled with a transparent fluid called the *aqueous humor*. Behind the lens in the inner chamber is a thicker substance known as the *vitreous humor*. The fact that the eyeball is filled in this manner aids in the maintenance of its spherical shape.

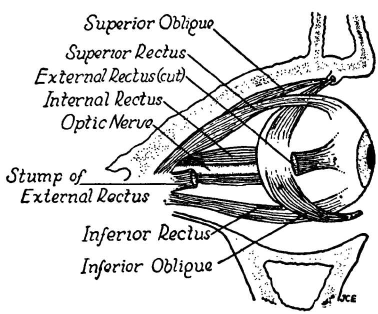

FIG. 22. THE MUSCLES OF THE EYEBALL

The retinal surface (illustrated in greatly magnified form in Figure 24), is a very complex structure. It is composed of layers of cells. That layer nearest the choroid coat is made up of rods and cones. These rods and cones contain chemical substances which are very sensitive to the stimulation of light waves. This chemical activity in the rods and cones is transformed into neural energy which is transmitted through successive layers of nerve cells and is finally distributed as a nerve impulse along the optic nerve. It first enters the mid-brain. From there other pathways lead to the occipital lobe of the brain.

The rods and cones are specialized structures. It is thought that they are differentiated so that the cones are sensitive to colored light and the rods to achromatic or colorless light. A proof of the validity of this idea is found in the general location of the rods and cones. At the central portion of the back of the eye cones are predominant, and in the sensitive spot immediately behind the center of the crystalline lens, called the *fovea* (a spot of clearest vision), only cones are found. The rods are located on the periphery of the retina. If the periphery is stimulated, even by an intense color, only a light response is received.

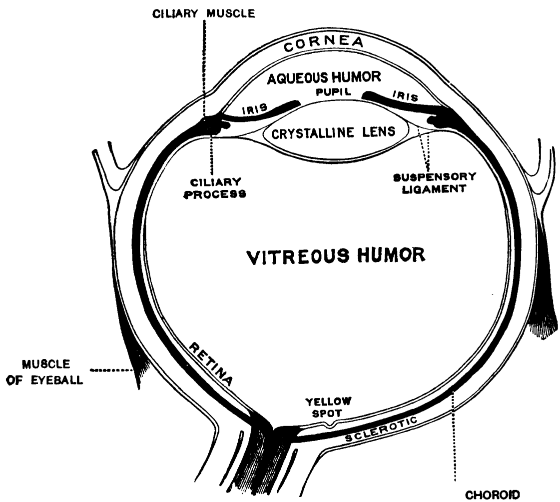

FIG. 23. CROSS SECTION OF THE EYE

The point on each retina where the optic nerve leaves the eye is known as the *blind spot,* because there are no sensitive cells to be found there. Under normal binocular vision we are never aware of the blind spot. When conditions are controlled, one may locate it on either retina. Follow the directions as given in Figures 25 and 26 and you will discover the blind spot.

The Physical Basis for Vision. Light waves are the adequate stimuli for visual sensitivity. A light wave is due to a vibration in a medium often called the ether. The range

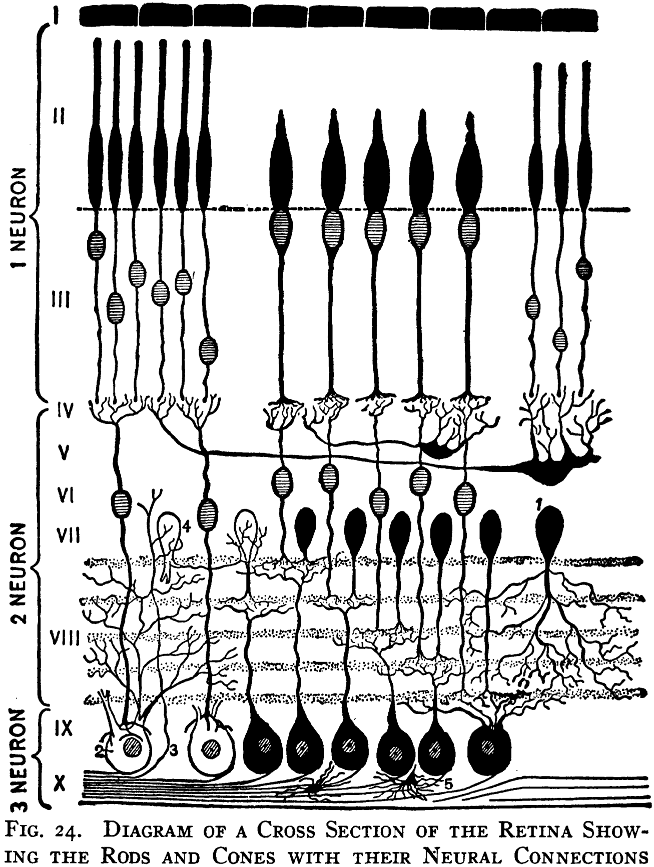

FIG. 24. DIAGRAM OF A CROSS SECTION OF THE RETINA SHOWING THE RODS AND CONES WITH THEIR NEURAL CONNECTIONS

I, the pigment layer; II, the rod and cone layer; III, the outer nuclear layer; IV to VIII, the layer of bipolar cells; IX and X, the ganglion cells and their nerve fibers which go to make up the optic nerve.

through which these vibrations become stimuli for the eye is well defined. The waves to which the eye is sensitive vary in length from 390 millionths of a millimeter (violet) to 760 millionths of a millimeter (red). The waves also vary in amplitude of vibration and in wave form. Light travels at a rate of 186,300 miles a second.

A word of explanation should be given here as to the meaning of these terms. The rapidity with which each particle of the wave oscillates is called the rate of vibration. The rate is the determining factor in the length of the wave from crest to crest. The shorter the wave, the more rapid the vibration rate and vice versa.

The amplitude of the wave is determined by the extent of the oscillation of each particle. The wave form depends upon

FIG. 25. THE BLIND SPOT

Hold the page directly in front of and about ten inches away from the eyes. Close the left eye and fixate the right eye upon the cross. Move the page slowly forward and backward. If the eye continues to fixate on the cross a point will be found where the circle completely disappears. At points both nearer to and farther away from the eye the circle is seen.

the total number of waves acting on the same particle at the same time.

Analysis of Color Sensitivity. The human eye is capable of distinguishing about one hundred fifty different hues. A person can pick out from an assorted pile of colored papers many different degrees of blue, green, yellow, red, etc. In doing so he may discover that some of these colors blend into one another. There is no hard and fast line of cleavage between them. This is to be expected because the colors in the spectrum do exactly the same thing.

Investigators have found that colors arranged in series may be classified in three ways. First, we may arrange them according to their selective *brightness;* second, according to their *hue* or color tone; and third, according to their *saturation* or purity of color.

In general, *hue,* or color tone, depends upon the *wave length* or the frequency of vibration of the light wave. *Brightness* depends in a general way upon the energy or intensity of the stimulus — that is, the *amplitude* of the light wave. *Saturation* is generally described as depending upon *wave form* or the

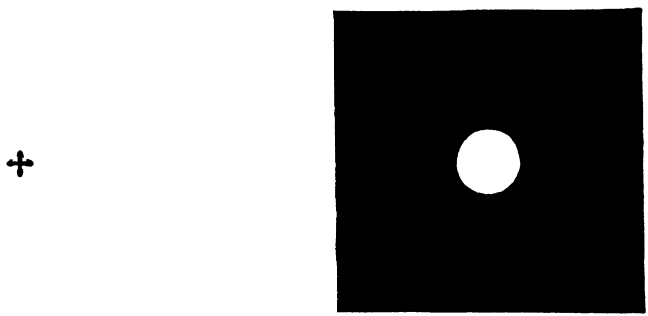

FIG. 26. THE BLIND SPOT

Follow the directions given for Figure 25. In this case the white spot will disappear and the entire square will appear black.

mixture of long and short wave lengths in any stimulus pattern.[1]

In Table III are classified the color qualities and their relative wave lengths.

1. *The hue series.* If an experimenter arranged various colored papers according to their hue, beginning with a red, he would find some reds that seemed to have a yellowish tinge and others that seemed to have a bluish tinge. In other words, from pure red one passes toward yellow in one direction and

[1] Another explanation for saturation has many arguments in its favor. Saturation is described as dependent upon the number of units of light per unit area on the retina. For example, if a certain amount of green be so arranged that it stimulates twice as much of the retina, the saturation will be half as great.

toward purple and violet in the other. From yellow the individual passes to green; then to blue. The hue series tends to run in a circle. We come back to red from the blue.

2. *The intensity series* runs from light to dark. Take any color and arrange various papers of the same hue in order of their brightness. From a brightness in which hue is barely discernible, we may pass through a well-saturated and uniformly intense area to a dark area in which hue is scarcely apparent.

TABLE III. WAVE LENGTHS AND COLOR QUALITIES

Fraunhofer's Lines	*Millions of Millions of Vibrations per Second*	*Wave Length*	*Color*
		$\mu\mu$	
A	395	760	Extreme red
B	437	686	Red
C	458	656	Limit of red and orange
D	510	589	Golden yellow
E	570	526	Green
F	618	486	Cyanean blue
G	697	430	Limit of indigo and violet
H	757	396	Limit of violet

3. *The saturation series* ranges from a hue that is a full-toned color to one that is pale or dull. A fully saturated color is one which is just as colorful as it can possibly be. Less saturated colors have a washed-out appearance. Minimum saturation approximates gray. White, black, and gray are often not considered as hues, but as differences in intensity, of which there are more than one hundred.

Figure 27 shows how all variations in saturation, hue, and brightness may be diagrammatically represented. The axis *WB* represents the grays from white to black. The edge of the intersecting plane represents all the changes in hue from blue (*B*), through blue-green (*BG*), to green (*G*), and so on through yellow, red, and the intermediate hues. Saturation is represented as one passes from the surface of the pyramid toward the center.

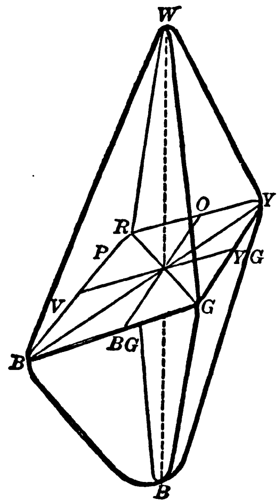

FIG. 27. THE COLOR PYRAMID

(From Titchener, *Text-book of Psychology*, copyright, 1910, by The Macmillan Company. Reprinted by permission.)

Facts of Color Vision. In connection with our ability to distinguish differences in hue, brightness, and saturation a number of very interesting facts have been discovered. We shall summarize these facts and then state two theories that have been advanced to explain them.

1. *Color mixing.* The customary way to mix colors in the psychological laboratory is to rotate disks the surfaces of which are divided into sectors of various color values. When such disks are rotated with sufficient speed, the component colors blend. Such blending may also be accomplished by using mirrors to reflect lights so that they fall upon identical parts of the retina. When colors are mixed in either of these manners, certain principles are found to hold.[1]

[1] Note that these principles do not always hold if paints or pigments are mixed. Color mixing by means of the color wheel or mirrors is based upon the same general principle as the superposition of one transparent color upon another. When pigments are used, however, the mixing controls the type of light waves which are reflected. These two methods of color mixing may or may not produce the same results. In the majority of cases they do not.

(*a*) For each hue one, and only one, other hue can be found which, when mixed with it, will give a colorless gray. Such colors are called *complementary colors*. In Table IV are given some illustrations of such complementary colors. The length of the color wave is in millionths of a millimeter.

Some idea of the relative hue of these colors may be gained by using the figures and descriptions found in Table III.

TABLE IV. TABLE OF COMPLEMENTARY COLORS FOR TWO OBSERVERS

Observer von Kries		Observer von Frey	
Long Light Wave in $\mu\mu$	*Complementary Short Wave*	*Long Light Wave in $\mu\mu$*	*Complementary Short Wave*
656.2	492.4	656.2	485.2
626	492.2	626	484.6
612.3	489.6	612.3	483.6
599.5	487.8	599.5	481.8
587.6	484.7	587.6	478.9
579.7	478.7	586.7	478.7
577.6	473.9	577.7	473.9
575.5	469.3	572.8	469.3
572.9	464.8	570.7	464.8
571.1	460.4	569.0	460.4
570.4	440.4	566.3	440.4
570.1	429.5	566.4	429.5

(*b*) If all the spectral colors are combined in proper proportions, the result of such a mixture will be a colorless gray.

(*c*) Four colors of proper hue, brightness, and saturation —

namely, red, green, yellow, and blue — when mixed in proper proportions will give a neutral gray. These colors are called *primary* colors.[1]

(*d*) When two colors which are not complementary are mixed in proportions other than those required to produce gray, the result will be an intermediate color. For example, if a small amount of green is mixed with an equal amount of yellow, the mixture will be a very light olive. Red and yellow when mixed give orange. If more red than yellow is used, the resultant orange will be reddish; if more yellow is used, the orange will be yellowish. All colors which are a mixture of other colors are called *secondary* colors.

2. *Color contrast.* Every color tends to tinge its surroundings with a color essentially its complement. This is true not only of hue but of intensity and saturation as well. A white object tends to darken the surface immediately contiguous to it, a dark object tends to lighten it. A red surface tends to tinge its surroundings a blue-green. In a similar fashion, shadows on snow are blue because of the yellow in the sunlight. This phenomenon is called *simultaneous contrast*.

The principles of simultaneous contrast are of special importance in the selection of articles of clothing and in interior decorating. Certain colors clash and others harmonize. This principle is also of major importance in the field of advertising. Much of the appeal of advertisements printed in colors depends upon the selection of harmonious color combinations.

Another sort of contrast, not greatly different from simultaneous contrast, is illustrated by the change from very bright illumination to darkness, or the reverse. In either case the

[1] It is true that yellow may be produced by mixing red and green in proper proportions. For this reason some authorities speak of three primary colors. Yellow is described by such writers as a secondary color.

change is more apparent than it would have been if one extreme degree of brightness had not been immediately preceded by another. Like simultaneous contrast, *successive contrast*, as this latter type is called, is found to hold not only for brightness but for complementary hues as well.

Successive contrast is made use of in the modern electric sign which flashes on and off. The contrast effects of these changes call attention to the design of the advertisement.

3. *Afterimages.* There are two kinds of afterimages: negative and positive. Gaze steadily at a blue paper for about twenty seconds; then look at a neutral background. On its surface will appear a definite yellow image. Now gaze at a brightly lighted electric bulb for a few seconds, and then turn off the switch. Luminous forms of the bulb will be visible for a short while. The former experiment illustrates the phenomenon of negative afterimagery and the latter, the phenomenon of positive afterimagery. Negative afterimages are always the complement of the inducing color, while positive afterimages have the same hue and brightness as the original stimulus.

Positive afterimagery plays a significant rôle in motion pictures. The positive image of the first exposure persists long enough to form the background for the succeeding picture. The new picture fuses into the positive afterimage of the preceding picture. The slight differences in the two pictures form the illusion of movement.

Negative afterimagery plays a rôle in the determination of theatrical stage effects when these are developed by means of lighting and color differences.

4. *Color blindness.* Color blindness is a phenomenon not very common in the human race. Only about three per cent of the male population and less than one-half of one per cent of the female population are color-blind. Red-green color blindness is most common. A person handicapped by this

disability is not able to distinguish between a red and a green light on the basis of the red and green components. He is forced to rely on differences in brightness, or some other appreciable difference, for his judgment. Blue-yellow color blindness is much rarer still. A person blind to blue and yellow would also be blind to red and green. His world would be made up only of light and dark — a series of grays.

It is apparent that color-blind persons would not be successful in certain types of work. The pilot of a steamer or the engineer of a railroad train would make many grave errors if he were unable to distinguish between red and green. Since the introduction of red-green traffic signals, many automobile accidents may be traced to this cause. Interior decorators, painters, advertising copy-writers, and many other types of workmen would be unable to get along satisfactorily if they were color-blind. Similarly, clerks and salesmen working in department stores at counters where colored goods are sold or clothing is matched would be inefficient.

One of the commonest methods of detecting color blindness and of determining the degree to which it is present is by using the Stilling charts. On a background of unevenly drawn blocks of its complementary color, a red or blue figure is imposed. On certain critical charts the color-blind person is totally unable to see the figure. A partially color-blind person is able to see the figures on only a few of the charts.

5. *Adaptation.* The eye is continuously stimulated by light or color as long as we are awake and active. During continuous stimulation the eye becomes adapted to any stimulus. When one goes into a dimly lighted room, such as a theatre, from a brightly lighted area, at first everything is a blur. Gradually, however, objects begin to appear gray and finally to become clear. Similarly, in gazing at a color, we become adapted. The result of the adaptive process is a less vivid

sensation from the light stimulus that is continuously active. Another evidence of adaptation is the sharpening of visual acuity that occurs when the person who is adjusted to a bright

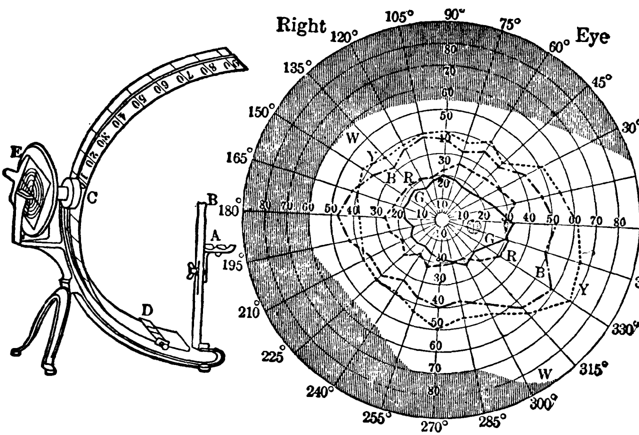

FIG. 28. A PERIMETER AND A PERIMETER RECORD OF RETINAL COLOR ZONES

The subject's chin is placed on the chin-rest (A), so that one eye is directly above the semicircular top of the rod (B). A small hole at the axis (C) serves as a fixation point. The color stimulus is moved on a carriage along one circular arm (D) toward or away from the center. The arms rotate so that all meridians of the visual field may be employed. On the back of the plate (E), which rotates with the perimeter arms, is fastened a paper disk, and on it are recorded the points along each meridian where the given color appears or disappears. A sample disk is shown at the right indicating areas of the visual field sensitive to green, red, blue, yellow, and white or gray, respectively. (From Dashiell, *Fundamentals of Objective Psychology*. By permission of Houghton Mifflin Company.)

light is suddenly placed in an environment where illumination is low.

6. *Peripheral vision and retinal color zones.* The retina is not equally sensitive to color. Move a piece of colored paper

from the point of direct fixation out to the limits of the field of vision and observe the effect. As the movement away from the fixation point progresses, the color changes in hue and finally appears as gray. The appearance of gray is merely a matter of intensity. Only the rods on the periphery of the retina were stimulated. Since the paper changed in color, we may infer that there are definite color cones located in the retina. Apparently a series of super-imposed layers of sensitive cells is present. At the center of the eye, all colors are visible. Sensitivity to green seems localized in that area. Sensitivity to red extends over about the same area, blue may be experienced farther away from the center, and yellow nearest to the periphery. The lines of demarcation separating these zones are not regular, and are subject to variation in different individuals. A typical pattern of these zones is shown in Figure 28. Persons who are color-blind to red and green have a narrowly restricted area partially sensitive to those colors, and even in that area, the organs are inadequately sensitive to red and green light.

There are other factors of vision which are important in man's adaptation to his environment. These for the most part have to do with defects in sensory acuity. A man may be severely handicapped by the lack of acuity in the rods and cones of his eyes. Such a handicap of acuity may extend all the way from total blindness to normal vision. There are also many defects possible in the functioning of the various refractive media of the eyes. Too great refraction of light, which causes the rays to focus in front of the retina, produces nearsightedness; too little refraction of light, which causes the rays to reach the retina before coming to a focus, produces farsightedness. Inequalities in the curvature of the cornea cause astigmatism.

While they have not received so much consideration by the psychologist, nevertheless these and other diseases and defects of the eyes, if serious, may have important effects on the person's adaptation to his environment.

Theories of Color Vision. There are two prominent theories of color vision. The older of the two is known as the *Hering Theory.* This theory holds that in the rods and cones are three distinct kinds of chemical substances. One kind is activated by red and green light; another by yellow and blue light; and a third by white and black, as well as by all the other colors. This chemical activity has two phases. One is

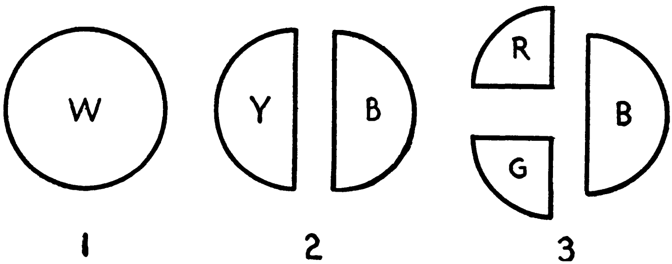

FIG. 29. DIAGRAM TO ILLUSTRATE THE LADD-FRANKLIN THEORY OF COLOR VISION

(Adapted from Woodworth, *Psychology*. Henry Holt and Company.)

a building up, or anabolic phase, the other is a breaking down, or katabolic phase. These substances have a zonal distribution in the retina. The blue-yellow substance is found intermediate between the periphery of the retina and the central portion where the red-green substance is located. The black-white substance is found in all parts of the retina. This arrangement is consonant with the findings in regard to retinal color zones. Blue, green, and black are supposed to be related to the building up, or anabolic, phase of the chemical activity, and yellow, red, and white with the breaking down phase. This theory is fairly adequate in its attempt to account for the phenomena of color vision. However, some difficulties arise in its application. Primary red and green do not give gray, but a grayish yellow when mixed together. Hering's account of the phenomenon of gray — namely, that complementary colors mix together as a cerebral phenomenon — is open to question.

The *Ladd-Franklin Theory* of color vision is based on a genetic concept. It supposes that originally the visual organ was sensitive only to gray series. At this stage there was no differentiation into color sensitivity. In the course of evolution, the so-called mother substance broke down or became differentiated into two components, one sensitive to blue, the other to yellow. Later in genetic development the yellow component became further differentiated, and sensitivity to red and green developed. This theory is adequate at most points with the exception of its poor account of the organism's sensitivity to black. The three stages of development are schematically illustrated in Figure 29.

XVI. Auditory Sensitivity

The ear is an apparatus designed to transform sound waves into nervous currents. It has mechanisms for enabling us to react differentially to tones of various pitch, intensity, and quality. It is very poorly equipped to give us knowledge concerning the location or source of a sound, but it enables us to judge effectively various sound sequences. It is primarily a time receptor.

The Human Ear. This organ possesses three well-defined sections: the outer, the middle, and the inner ears. (See Figure 30.)

The outer cartilaginous organ, known as the *pinna,* or ear trumpet, serves in a rather rudimentary way to concentrate the sound waves and direct them toward the inner ear through a cylindrical canal called the *external meatus.* The pinna and the external meatus constitute the *outer ear.*

The *middle ear* is a cavity which contains three small bones called the *malleus* (hammer), *incus* (anvil), and *stapes* (stirrup). The malleus is connected at one end to the tympanic membrane, which is stretched across the outer end of the middle ear, and to the incus at the other. The stapes is connected to the wall of the oval window of the inner ear at one end and to the incus at the other. The incus is suspended from the roof

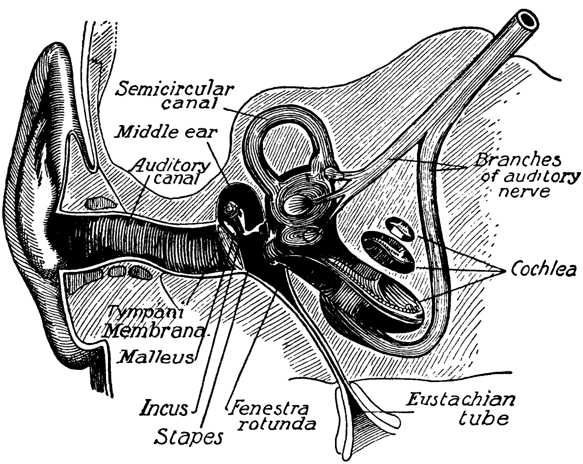

FIG. 30. CROSS SECTION OF THE EAR

of the middle ear by a tendon, making possible a free swivel movement. It is activated by the displacement of the malleus, which occurs when the ear drum vibrates to the sound waves which affect it. These bones are really a system of levers which transmit the vibration of the ear drum to the oval-window membrane. The middle ear is connected with the throat by means of a canal known as the Eustachian tube. This connection makes it possible for the cavity to have an air pressure approximately equal to the atmospheric pressure at the body surface.

The *inner ear* is divided into three parts: the *vestibule,* the *semicircular canals,* and the *cochlea.* It is the cochlea which is chiefly concerned in the auditory processes.

The cochlea is a cavity winding two and a half turns about a central core of bone. It is longitudinally divided by shelves which project from the bony core and by certain membranes of which we shall speak later. The shelves and membranes divide the cochlear cavity into three canals: the *scala vestibuli,* the *scala tympani,* and the *cochlear canal.* The scala tympani is partially separated from the rest of the cochlea by the bony shelf and a membranous extension called the *basilar membrane.* The basilar membrane is made up of many fibers which differ in length as the membrane passes from the lower to the upper extremity of the canal. At the lower end, the fibers are short, while at the upper end, they are about twelve times as long.

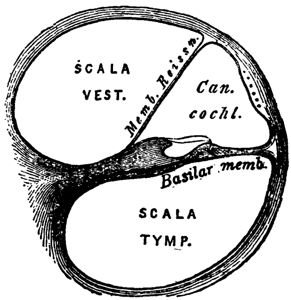

FIG. 31. CROSS SECTION OF THE COCHLEA

The scala vestibuli is not so large in area as the scala tympani because another membrane, known as *Reissner's membrane,* extends from the upper side of the bony shelf obliquely toward the roof of the cochlea, forming the cochlear canal, or duct, in conjunction with the basilar membrane. The relation of these parts is illustrated in Figure 31.

One other important set of structures in the ear must be mentioned. Directly on the basilar membrane is a system of receiving cells called the *organ of Corti.* The rods of this organ form an arch extending across the membrane. They are capable of taking up any vibration which sets the fibers of the membrane in motion. Distributed to the fibers of the membrane themselves and extending between the rods of Corti are the hairlike endings of the auditory nerve which are excited by activity of the fibers and rods.

By means of these structures a sound wave from the outer ear is transformed into a neural impulse. When a sound wave reaches the trumpet part of the ear, it passes down the external meatus and strikes the ear drum. The ear drum vibrates according to the rate and intensity of the stimulus affecting it, and its rhythmic movement in turn causes a movement of the ossicles of the inner ear. The liquid in the inner ear is set in motion by the activity of the membrane at the oval window. This movement is carried along the scala vestibuli and the cochlear duct and, in passing, causes a stimulation of the auditory nerve in the organ of Corti. The scala tympani is the canal which carries back the vibrations after they have done their work, so to speak. At its lower end this canal is enclosed by a membrane covering a tiny opening called the *round window*. This makes possible a transference of the stimulation out into the internal meatus, rather than a reflection of it back into the vestibule proper.

This description of the function of the organs of the ear is based on the principle of sympathetic resonance which Helmholtz, a German physicist, developed. Other theories of hearing have been advanced. Max Meyer holds to a hydraulic theory. Another theory, known as the telephone theory, is based on the fact that the membrane behaves like the diaphragm of a telephone receiver. Data are inadequate to evaluate properly any of these theories. Suffice it to say that the Helmholtz theory, in spite of its difficulties, is commonly accepted.

The Physical Basis for Sound. A sound wave is a longitudinal wave. When any vibrating object strikes the air particles surrounding it, they are pushed together and then rebound from one another, producing alternate conditions of condensation and rarefaction. When sound waves strike upon the sensitive receiving mechanism of the ear, the process of hearing begins. If the alternate condensation and rarefaction set up in the air by a vibrating body equal or exceed 16 to 20 per second, the ear is stimulated. This is the lowest rate of vibration to which the ear is responsive. When the rate exceeds 30,000 to 35,000, the ear is not tonally affected. Between these two limits it is possible for the average human being to discriminate about 11,000 different pitches. It is well to remember that there are marked differences among individuals in their ability to make pitch discriminations.

Some Auditory Phenomena. Sounds are of two kinds, tones and noises. When the sound waves occur in regular succession for some time, they produce tones; when they are irregular or occur only for a small fraction of a second, they produce noises.

A pure tone is one caused by a succession of waves having the same vibration rate. It may vary in two important ways: in loudness, or intensity, and in pitch. Its form is simple. We rarely get pure tones except under controlled conditions in which special instruments are used, such as a tuning fork.

Ordinarily tones are complex; that is, they possess a certain fundamental character plus accompanying overtones. For instance, a violin string produces a complex tone because it vibrates not only as a whole, but also in parts; so does the wire string on a piano. Suppose the same pitch is struck on both of these instruments. The pitch will be the same, but the character of the tones will be different. This difference is due to the character of the overtones.

If two tones having nearly the same vibration rate are simultaneously produced, a definite beat will be set up between them. The number of beats per second will equal the difference in rate of vibration between the two tones. If that difference becomes great enough — that is, greater than about 16 vibrations — a third tone, known as the *difference* tone, may be heard. Under certain conditions there may be heard a tone having a rate of vibration equal to the sum of the two vibration rates of the tones. This is called a *summation* tone. It is difficult for the untrained person to hear either of these tones. They do not seem to be purely physical facts explicable in terms of the physical effect upon the air particles; rather they seem to be due to certain physiological processes within the ear itself. They are, therefore, sometimes called *subjective tones.*

These forms of auditory phenomena are found in various combinations, giving a quality and a richness to our tonal experience that we would not otherwise have. Man has developed his control over tonal phenomena in the form of music and, in the whole psychology of sound, no more important and difficult problems have arisen than those relating to the nature of consonance and dissonance. Some tonal patterns are made up of components that are distinctly pleasing, or consonant; others are rather unpleasant to hear, or dissonant. The selection of tones for musical purposes is determined by the consonantal relationship they have to each other. The musical scale is based primarily upon the fact that any tone the vibration rate of which is twice that of another will blend pleasingly with it. Two tones bearing this relationship to each other form an octave. The octave has been divided into seven steps not all of equal length. The tonal combinations in some of these steps are æsthetically pleasing, while others have little or no harmonic relationship.

Importance of Sound. Sound, of great importance in the life of all higher animals, is especially so in man. Spoken language depends upon tone production. While gesture and grimaces no doubt were the original means of communication, the voice is now its chief means. Man would be a very different animal if he did not have his auditory sense. Social development probably depends upon this sense more than upon any other.

Sound has also had a large place in the æsthetic development of the race. The forms of music are varied, but the fundamental basis of all music is found in tones and the relations between them.

With the increased use of machines, the effect of noise upon human welfare has become an important problem. Noises vary from the steady hum of a motor to the screeching of whistles, the grinding of brakes, and the crash of metal upon metal. We do not know the effects of such noises upon the physical and emotional welfare of man. There is some experimental evidence to indicate that loud noises of high pitch tend to disintegrate body tissue. Other types of noises may produce harmful effects through association. At present the National Safety Council is making a thorough study of noises and their harmful effects. Engineers tell us that harmful noises can be eliminated, but only at great cost. Before any steps toward the elimination of noises are taken, we must discover which are the harmful ones.

XVII. Cutaneous Sensitivity

Cutaneous sensitivity as we experience it in ordinary life is the result of complex combinations of stimulations impinging upon various sense organs in the skin. The components of these combinations may be discovered by exploring a portion of the skin with different stimuli.

Receptors. The skin is like a mosaic pattern containing at least four different types of end-organs. There are highly arborized, free, unsheathed nerve endings which are specialized to respond to intense mechanical or thermal stimulation. These are the receptors for pain. Fine nerve endings encircling the roots of the hair, and, on the hairless parts of the body, the Meissner corpuscles (a mass of nerve endings enclosed in a delicate membranous tissue) are the receptors for pressure. It is thought that the end bulb of Krause is the cold receptor and

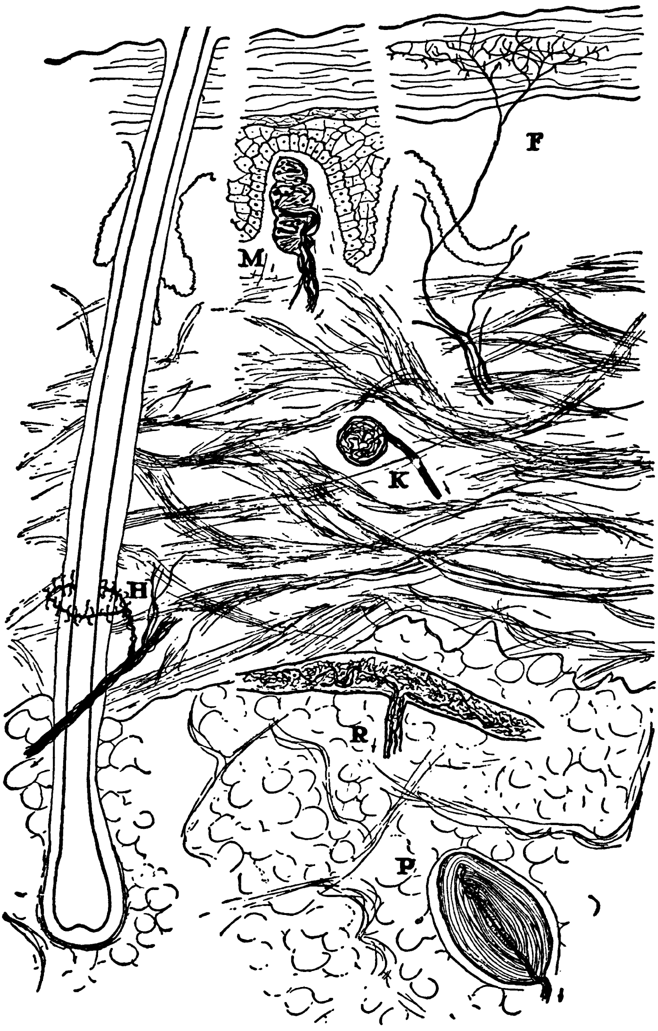

FIG. 32. TYPICAL CUTANEOUS RECEPTORS
(See footnote on opposite page for explanation.)

the Ruffini corpuscle, the warmth receptor. These various end-organs in the skin are shown in diagrammatic form in Figure 32.

Experimenters have estimated that there are from two million to four million pain spots on the body, about five hundred thousand each of cold and touch, and about thirty thousand warm spots. This does not mean that every tiny part of the body contains sensitive end-organs. If one were to explore a square inch of skin on the arm, he would discover spaces which did not respond to stimulation of any kind. There are other points which respond to one type of stimulus but not to others.

Physical Basis of Cutaneous Sensitivity. All stimuli, when presented at a certain intensity, stimulate the pain receptors. Certain conditions govern this reaction. Temperature below 12 degrees centigrade and above 50 degrees will stimulate the pain receptors. Sudden heat will cause pain, but the same temperature gradually attained will not. Certain visceral pains are caused by chemical action, others by pressure. Sometimes slow pressure will cause pain receptors to respond, whereas rapid pressure, as in a knife thrust, causes no response from these receptors. Temperatures between 12 degrees and 28 degrees centigrade activate the cold receptors; below 12 degrees both cold and pain are activated. From temperatures varying between 28 and 45 degrees come stimulating conditions which activate warmth receptors. Beyond that point, warmth and

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Explanation of Figure 32.

F, free nerve endings, formed by fibers that have lost their sheaths (*pain receptors*); *M,* Meissner corpuscle (*pressure receptors*); *K,* Krause end blub (*cold* (*?*) *receptors*); *H,* nerve endings about hair follicle (*pressure receptors*); *R,* Ruffini corpuscle (*warmth* (*?*) *receptors*); *P,* Pacinian corpuscle (*deep pressure receptors*). For convenience the receptors are not represented in true relative sizes. All are actually much smaller in comparison with the depth of skin layers; some (Meissner and Krause) are actually much smaller in ratio to other receptors shown, while one (Pacinian) is actually much larger. They are shown more closely grouped than is probably ever the case. (From Dashiell, *Fundamentals of Objective Psychology.* By permission of Houghton Mifflin Co.)

pain are activated, producing a response of burning heat. Mechanical stimulation, varying from very light to relatively great intensity, brings a response from the pressure receptors.

Cutaneous Phenomena. As a rule, a large number of cutaneous receptors are stimulated at once. Usually it is only under controlled conditions in the laboratory that a single sense organ in the skin is isolated and stimulated. Pressure, warmth, cold, and pain are usually active in combination. As a result, we have such responses as smoothness, roughness, tickle, hotness — all due to combinations of cutaneous sensitivity.

Pressure, warmth, and cold show certain adaptive effects. Water that at first is uncomfortably warm gradually becomes satisfactory for bathing purposes. The warmth spots have been active, but adaptation has taken place. The same phenomenon occurs with pressure and cold. Pain however does not show the same effects of adaptation that other types of cutaneous sensitivity do. Under emotional stress and strain pain may not be as effective in inhibiting activity as at other times, but there is little evidence to support the idea that prolonged stimulation of pain receptors produces a progressively less intense response on the part of the organism.

The cutaneous senses give the child much of his intimate knowledge of the world about him. The child continually tries to touch and handle objects. It is by this method that he learns many of their most significant qualities. This is less true of the adult. Once he has learned these intimate facts about objects, he uses his distance receptors more. Vision and hearing play a more important rôle in the life of the adult.

XVIII. Gustatory Sensitivity

All tastes may be classified into four fundamental groups: sweet, salt, bitter, and sour. In a general way specific receptors for each of these may be found located at different points on the tongue. Many of the experiences which we regard as taste experiences are in reality based on a stimulation of the olfactory end-organs.

The End-Organs for Taste. These organs are to be found on the sides of the foliate, the fungiform, and the circumvallate papillae on the tongue. These papillae are really folds of skin on the surface of the tongue. The sense endings proper are

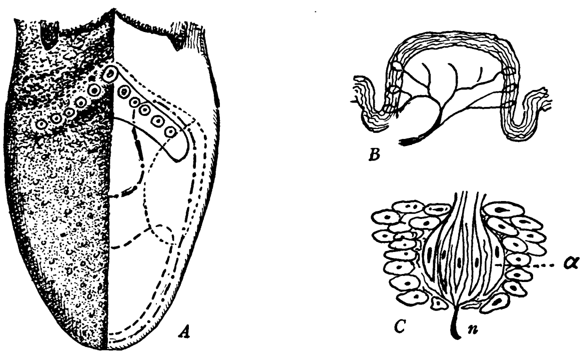

FIG. 33. SENSE ORGANS OF TASTE

A, map of the upper surface of the tongue showing on the left the different kinds of papillae and on the right the areas of taste. (After Hall) Area sensitive to bitter (———); to acid (....); to salt (-.-.-.); to sweet (- - -).
B, section through a papilla showing nerves connecting with taste buds. *C*, single taste bud magnified: *n*, nerve, the fibers of which terminate between the spindle-shaped cells, *a*.

specialized cells located in the *taste buds*, or *beakers*, which are arranged along the side of the depression made by the papillae. (See Figure 33.) A taste bud is a group of nerve endings with certain supporting cells. As the papillae are scattered rather widely over the tongue, we find the receptors differentiated for gustatory sensitivity on almost every part of the tongue. In childhood some are also embedded in the soft palate and the linings of the pharynx.

Taste buds are stimulated by certain chemicals in solution. Some react to sweet substances; others to sour, salt, or bitter substances. Those buds sensitive to sweet are found in greatest number on the front area of the tongue. Those sensitive to sour substances are found on the sides of the tongue. Bitter substances excite the end-organs at the back of the tongue most effectively. Salty substances activate end-organs spread generally over the tongue. In many papillae, several taste buds, differing in sensitiveness to various kinds of substances, may be found. If a little alum is placed on the tip of the tongue, it tastes sweet. Placed on the back of the tongue, it tastes bitter.

XIX. Olfactory Sensitivity

Olfactory sensitivity, very useful to some of the lower animals, is not so important in civilized man as are the higher senses. Odors are hard to classify because they are very complex. Since they depend on very small particles of odoriferous substance, our adaptation to them is extremely rapid.

The End-Organs for Smell. At the upper end of the nasal cavity there is a sensitive membrane, having an extent of about 250 sq. mm. in each nasal chamber, in which are embedded the sensory cells differentiated to respond to chemical stimulation in gaseous form. (See Figure 34.) These receptors are very simple in structure. They are true nerve cells with tiny hair-like cilia on their surfaces. These cilia, when affected by chemical particles, activate the sensory nerve directly. Because it is difficult to investigate the area, we do not know whether there are specialized organs present or not. Smell does not lend itself to classification as taste and vision do. The classification of odors to which man responds is a most difficult task. Zwaardemaker, Henning, and others have proposed certain groupings. Until more complete and controlled experimentation has been made, any classification must necessarily be tentative. Henning's classification is as follows:

Fruity Odors, such as are found in apples, grapes, oranges, etc.
Flowery Odors, found in pansies, carnations, etc.
Spicy Odors, found in cinnamon, cloves, etc.
Resinous Odors, found in pitch, balsam, turpentine, etc.
Smoky Odors, found in burnt substances, tar, etc.
Putrid Odors, found in decaying matter, asafoetida, Limburger cheese, etc.

Naturally, this list is not adequate since there are many odors which cannot be classified in any of these groups.

Gustatory and Olfactory Phenomena. Taste and smell are closely related. They seem to reënforce each other in their effects on the individual. Coffee has a pleasant odor and a bitter taste. Under conditions where olfactory acuity is reduced, as by a cold in the head, coffee is not very enjoyable. Adaptation is very rapid in both taste and smell. For example, if you stimulate the end-organs with camphor, the intensity of the stimulation will rapidly subside until you are incapable of smelling the odor at all. This may make you more sensitive to another odor, but smell exhaustion takes place always when a stimulus is applied for some time. This is why many persons, upon entering a paint store or a tannery, wonder how the workers can stand the smell. The fact is they have become adapted and notice the odor only upon returning after an extended stay in the open air.

The close relationship existing between taste and smell has a definite basis. Biologically, next to the tactual sensitivity of the organism, smell is considered the most primitive sense. In lower organisms, it was the most important sensory process. When the eye began to achieve a more adequate differentiation, smell began to play a minor rôle in sensory adjustment. In man, taste and smell still stand guard over the substances to which the organism is responsive and which it may assimilate. Foul air is not healthful. Awareness of it brings about a change in condition. Of course there are times when our judgment leads us to modify what would be the expected response

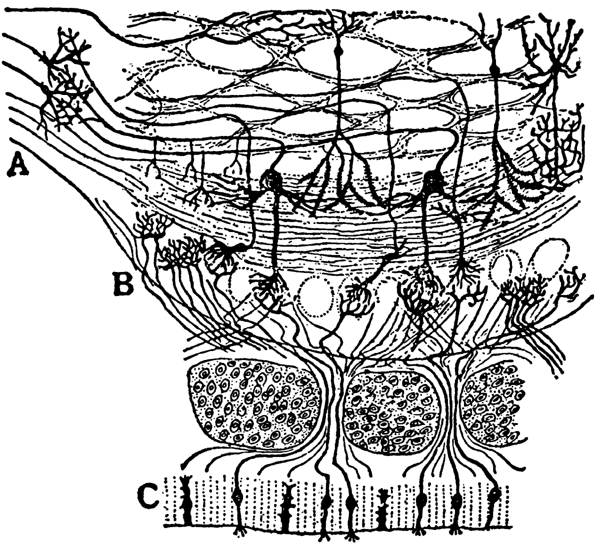

FIG. 34. DIAGRAM OF THE OLFACTORY ORGAN AND ITS NEURAL CONNECTIONS

C, a layer of olfactory spindles with their hairlike projections just above the surface of the lining of the nasal cavity. At B the nerves connecting with the olfactory spindles pass upward toward A on their way to the brain. (From Barker, *The Nervous System*. D. Appleton and Company.)

to a sense organ. Bitter medicine is hard to take, but we overcome a natural distaste because of other ends more desirable than immediate pleasant sensory experience. Thus we get beyond the biological level of survival.

XX. Other Forms of Sensitivity

Other forms of sensitivity are kinæsthetic, static, and organic. Although these forms do not enter into our higher intellectual processes to the extent that vision and hearing do, and although they do not play so important a rôle in our social adjustments as cutaneous, gustatory, and olfactory sensations do, nevertheless they influence our adjustment to our environment in several important ways. For that reason, they should not be neglected in our study of sensory activity.

Kinæsthetic Sensitivity. The muscles, tendons, and joints of the body are supplied with certain nerve endings which constitute the receptors that are aroused by the movement of any of these structures. It is essential that the muscular and skeletal adjustments of the organism be coördinated and balanced. This is achieved by the relationship existing between the sensory impulses derived through the excitation of the kinæsthetic endings and of certain motor impulses distributed back to the musculature of the body. Most of us are aware of the relative position of arm or limb at any moment, although we may make little conscious use of that awareness. If attention were necessary to maintain any given muscular position, it would constitute a great handicap to our ordinary activity. The mother who had continually to attend to the position of her arm while holding her child would run great risk of seriously injuring the child, should excitement or other conditions draw her attention from the arm. Normally, walking is largely unconscious, because each successive muscular contraction acts as a stimulus to other muscular contractions, owing to the presence of kinæsthetic sensitivity. We balance ourselves, control our movements, and integrate behavior patterns into coördinated wholes through this sensitivity, which comes from the stimulation of end-organs located in the muscles and tendons.

All our movements, therefore, are dependent upon kinæsthetic sensations for guidance and control. While other types of receptors receive the stimulation that produces movement, the control of the form of movement and its adaptation to skilled acts are dependent upon kinæsthetic control. The pitching of a baseball, the hitting of a golf ball, the guiding of an automobile, and the control of a lathe or drill press are controlled indirectly by kinæsthesis. It is true that vision and the tactual sense play a large part, and the loss of any one form of these controls would result in a great decrease in voluntary control. By training, however, one sense could probably be substituted for another — such as touch for vision — but the kinæsthetic sense could be dispensed with least easily. From those relatively few cases in which this sense is temporarily disturbed by pathological conditions, we get some idea of its importance in life adjustments.

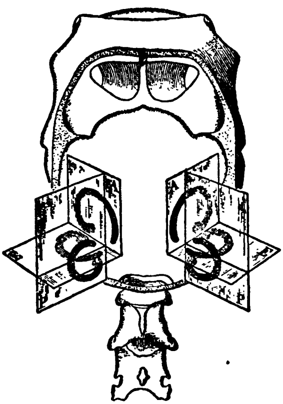

FIG. 35. SCHEMATIC DIAGRAM OF THE SEMICIRCULAR CANALS SHOWING THEIR RELATIVE POSITION TO EACH OTHER

Static Sensitivity. When we were discussing the ear, we mentioned the fact that the inner ear contained the semicircular canals, as well as the vestibule and the cochlea. The semicircular canals and vestibule are not connected with hearing, but they do function in aiding us to keep our balance.

The semicircular canals are hollow tubes filled with liquid distributed in three planes. Hairlike endings of a division of the eighth cranial nerve extend into the base of these canals where they join the vestibule. Any movement of the body causes a change in the pressure of the liquid in these canals and thereby stimulates the receptors. The action of these canals can be understood by reference to Figure 35. The compensatory movements of the body which bring about a new balance after movement are reflexly conditioned. The effort to readjust the body after even slight disturbance is essential if equilibrium is to be maintained.

If injury occurs to these canals or disease retards their functioning or malformation of the inner ear inhibits proper development, marked defects in orientation of the body are noticed. Excessive stimulation of the semicircular canals by whirling or spinning creates a condition in which equilibrium is temporarily lost. The compensatory movements carried on by the individual to negate the loss of static orientation are interesting. If a person is placed in a rotating chair, it will be observed that as long as the rate of acceleration is increasing, the person will show alternating movements of his eyeballs; that is, there will be a jerky movement in the forward direction. Certain muscles slightly twist the trunk and there is apparent activity in the legs in the form of lateral straining. When the speed of rotation becomes constant, there is a retardation of trunk and leg movements and the eyeballs cease their activity. Then when the speed of rotation is decreased, the reverse eye movements are noted, and trunk and leg muscles twist and strain in the opposite direction.

When the excitation of the sensory endings in the canals becomes extreme, certain visceral discomfort is experienced and dizziness occurs. There are many investigators who suggest that the semicircular canals also function in maintaining bodily tonus.

Organic Sensitivity. There is a complex of sensory processes which results in what is known as organic sensitivity. Hunger, thirst, nausea, suffocation, and certain other visceral disturbances coming from the lower bladder, rectum, and sex organs are identified in this group. Owing to the fact that experimentation in this field has been very limited and the sensory mechanisms involved are so difficult to isolate, our knowledge of organic sensitivity is very meager. Hunger appears to be identified with the muscular contractions of the walls of the empty stomach. Thirst seems to be due to irritation of certain mucous linings of the throat. More complete discussion of organic sensitivity awaits further experimental work.

Differential Sensitivity and Adjustment. From this discussion it should be clear that sense organs are the gateways through which man meets his world and comes to know what it demands of him in the way of adjustments. Without normal vision the worker is handicapped and his efficiency is decreased. The eye must guide the hand and function as an adequate means of control in many skilled acts. Industrial hazards become greater when the person at work cannot hear. Even crossing a street in a busy city or driving a car in a crowded street becomes a difficult task when either hearing or vision is impaired. While we are more aware of the importance of visual and auditory sensitivity than we are of many other types of sensory activity, the importance of these latter processes cannot be overlooked. Kinæsthetic sensitivity, as we have just pointed out, is the basis for the control of parts of the body in relation to other parts. The skilled movements involved in many types of industrial relations are maintained in their significant patterns by means of the kinæsthetic function. In fact there is scarcely a single sensory capacity possessed by man which does not contribute in some way to his success or failure in life. The normal functioning of end-organs with its accompanying adequate sensitivity is the basis for satisfactory adjustment. The color-blind engineer or the deaf telegraph-operator is an anomaly; so is a singer without adequate pitch discrimination or a tea-taster without highly sensitized taste buds. In business and industry, as well as in the arts, normal sensitivity is the basis for successful adjustment.

Summary. Throughout this chapter we have been studying sensory activity. It is important to remember that every end-organ, no matter how specialized, has a definite relationship to the organism as a whole. The constant influx of sensory impulses to the cord or brain involves a constant efflux of motor impulses to the muscles and glands of the body. The world to which the organism adjusts, both externally and internally, is complex and continuous. Very rarely is a living organism entirely out of contact with it. Indeed, living, in the biological sense, is the process of continual adjusting required of an organism in order to maintain a nice balance between itself and its environment. We noted that there are no specialized end-organs in the amœba; consequently there is no division of labor. In man there are many specialized sense organs and many specialized muscles and glands. The tasks involved in adjustment are divided among them; yet all must work together if survival is to be maintained. The eye and the ear assist each other. Taste and smell, temperature and pressure combine to enrich and make more effective the sensory adjustments made possible through their particular type of specialization.

All that the receptors do is to bring first-hand impressions of the environment to the organism. The further task of adjusting, in the light of environmental need, remains. In subsequent chapters, we shall discover the way in which relationships between the organism and its environment are maintained and made more effective. This is a problem of the elaboration of behavior upon the basis of primary sensory adjustments on the one hand and simple muscular adjustments on the other hand.

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CHAPTER V

ATTENTION

XXI. Essential Characteristics of Attention

The attentive processes are intimately involved in very many practical problems of life. On this account we are warranted in studying the nature of these processes. We shall find that attention continually fluctuates, that its focus shifts from one point to another, that only a few objects can be attended to at one time, but that, in spite of this narrowness of range and these fluctuations, we are continually attending to something.

Problems Involved in Attention. Every person is vitally concerned with the phenomena of attention. We set ourselves to some task and find our mind wandering to a foreign subject in spite of our apparent efforts to concentrate upon the assigned task. We start to read a book only to find ourselves becoming drowsy; perhaps we are eventually overtaken by sleep. How can we control our attention so as to hold to our assigned task, shut out irrelevant thoughts, and keep from going to sleep? The experienced dentist can keep his patient from thinking too insistently about the unpleasant drilling in his tooth. The sleight-of-hand performer owes his success to his ability to get the attention of his audience upon one act while he performs another. The success of the advertiser depends largly upon his ability to present advertisements which attract the attention of the public. The task of the speaker, be he lawyer, preacher, politician, or pedagogue, is to keep the attention of his auditors upon what he is saying. Furthermore, a person who deals with others must understand the objective signs of attention, so that he can tell whether his auditors are attending to him. The day is past when a speaker can read his message from a manuscript with apparent unconcern as to whether his audience is listening or sleeping. The modern audience will not listen to a speaker who cannot hold its attention, the reader will not read a book which will not keep him interested, a salesman cannot sell if he cannot hold the attention of the prospective buyer long enough to convince him of the merits of the product, and even the speaker over the radio will be tuned out if he cannot keep his audience interested. Whatever our position in life, we are all vitally concerned with the activity of both our own attentive processes and those of others.

Attention Is Always Occupied. There is no time in a person's waking life when he is not attending to something. When we say a person is inattentive, we do not mean that he is attending to nothing, but that he is not attending to the thing that we should like. If a person sits and looks at us with a vacant stare while we talk, apparently not hearing a word we utter, it is not because his mind is a blank, but because he is thinking of other things. He may be thinking of his latest love affair, or he may be making plans for the future, or he may be wishing we would not bother him, but in any case he is thinking of something.

There are times when a person may apparently go into a reverie and be lost to all around him. When he comes " back to life," he may claim that he was not thinking of a thing, that his mind was blank; but investigations have shown that in such periods of " absence " there are mental processes at work, often of very vital importance to the individual.

This indicates that the question, " How can I increase my ability to attend? " is equivalent to the question, " How can I keep awake? " So long as we are awake, we are attending to something. There are varying degrees of alertness, and some persons go through life half asleep because existence is to them a succession of drab events none of which has sufficient significance to make them attend. If life is filled with striking experiences, we have no trouble in keeping awake. The development of attention, as we shall learn, is centered almost exclusively around the problem of how to direct the attention to a series of objects or thought processes which are of enough vital significance to keep one alert. The development of attention is, in short, the development of ability to control the movements of attention.

Nature of Attention. At any one moment of our waking life we may find that some things are very vivid to us while others, although we are aware of them, are not so clear. Yet there is evidence to prove that we may be influenced by sensory impressions of which we are totally unaware. We may sometimes think that we are selecting at each moment one single item of experience and responding to it, but careful investigation shows that our conduct is determined not by one item alone but by the entire combination of elements which make up the total situation.

In this mass of impulses which are present at any one moment, there are often contradictory elements. If all the opposing elements were evenly balanced, they would neutralize each other, so that we would be in a state of equilibrium and no reaction would occur. Such a situation seldom, if ever, exists. At one moment one element is dominant, and at another moment, some other element is. Our activity seems to be determined largely by the stimulus which is dominant in the group of active stimuli at the moment. This momentarily dominant stimulus, the one which controls to a large extent our response, is the one to which we attend. Attention means that one element plays a dominant rôle in our behavior. To say that we are attending to a stimulus, whether to an external stimulus or to an internal ideational process, is simply to say that we are reacting to it more strongly than to other stimuli operating at the same time. This should make clear that attention is simply a name for a process, the process by means of which some element, or small group of elements, becomes selected from the mass of stimuli and controls, for the moment, our behavior.

Furthermore, we must keep in mind that the relative force of the various stimuli playing upon us is constantly changing. Noises, lights, tactile impressions, and internal stimulations are all playing upon our organism with varying degrees of force; all are in contest for the complete control of our reactions.

In addition to the changing character of competing stimuli another factor which may determine the nature of the reaction we shall make is the readiness of the organism to respond in any one manner. We may be set to see a ghost as we walk by the cemetery, to hear a burglar when we sit alone in the house at night, to see printed characters when we open the pages of a book, or to feel the cold wind when we step out of the door. We may apparently be listening to a lecture, but in reality the mind may be so set to brood over a recent bereavement that the slightest suggestion upon the part of the speaker will divert our attention into a chain of reverie about our troubles. That is, our attention wanders from the speech because our nervous system is set to think about our troubles.

Attention Continually Fluctuates. A very important characteristic of attention is that it continually fluctuates. We cannot keep our attention on one specific item of experience for a long time. If the reader is skeptical about this statement, let him make a dot on a piece of paper and attempt to keep his attention centered on it for a considerable period. He is sure to find it impossible. He will find himself thinking of other things — what kind of paper it is, how long he has been looking, whether this experiment really proves anything, what good is psychology if one cannot fix his attention on a thing, and a host of other ideas.

This does not mean that the same idea cannot keep recurring. In some instances we try to prevent some thought from dominating our attention but it insistently comes back again. Analysis will show that it does not stay there, but it is no sooner displaced by another thought than it again gains the ascendency.

If we permit ourselves to attend to various details connected with one general subject, our attention is fluctuating, but at the same time it is fixed on the general subject. Far from being a disadvantage, the fluctuations of attention are a decided advantage to us. Instead of fixing our attention on a minute detail in a manner that would lead to sure stagnation, we grasp one detail, and then shift to another related detail, and again to another. On this account the fluctuations of attention are an essential element in the process of making our adjustments. They make possible continually changing reactions in harmony with the changing situations operative around and within us. We should never attempt to stop the fluctuations of attention; rather, we should learn the laws of fluctuation and thus direct the shifts.

Meaning Facilitates Attention. Experiences have meaning only in so far as we are familiar with their details. It is the shifting character of attention which makes possible the investigation of these details. When a person says that he cannot keep his attention on a thing, it indicates that he needs to get more intimately acquainted with the subject rather than to control his attention. The printed page cannot long hold the attention of one who cannot read, but let the details of that reading matter be known, and he has little trouble in following the type.

In order to control your attention, learn the meaning of the experience you encounter and the shifts of attention will follow this meaning.

Rapidity of Shifts of Attention. Many experiments have been performed in the attempt to determine the rapidity with which attention shifts. The results are not at all conclusive. In some instances the shifts occur every few seconds, while in others they occur as far apart as a minute. Most of these experiments have been concerned with the shifts of very faint sensory impressions.

One such experiment that may be easily performed is as follows: Get far enough away from a watch to make the ticking barely audible. If you listen intently, you will find that at intervals the ticking becomes inaudible. A similar experiment is to look intently at a faint gray line. The line will periodically appear and disappear.

Various attempts have been made to explain these sensory shifts in relation to some bodily rhythm such as the breathing, the heartbeat, or the like, but it has been found that they do not correspond to any definite physiological rhythm. They may be somewhat different from the shifts of ideas about which we have been talking, but evidence seems to point to the fact that they are of the same general nature.

Span of Attention. The question has been asked, "How broad in scope is attention?" An interesting method of answering this question has been devised by psychologists. It consists essentially of exposing to the senses for a fraction of a second a varying number of objects and determining how many of them the subject can perceive during the brief exposure.

In the field of vision an instrument called the tachistoscope is used for this purpose. It has a shutter which opens and exposes for about a quarter of a second the material placed behind it. It has been found that as many as five separate impressions (points, lines, numbers, or letters) can be distinguished when they are thus exposed. When more than five are exposed, there is likely to be confusion and the subject will make errors in reporting the number seen.

While the span of attention is limited to about five discrete objects, it may be indefinitely increased by arranging the material in a meaningful manner. For example, if we should expose the letters I A H C G O C, it is quite likely that a single exposure would be insufficient for us to perceive all of them. Should we arrange them so as to give them meaning, as C H I C A G O, we could all grasp them on the first exposure. If the subject were illiterate, it is quite unlikely that he could grasp even three of the letters, such as I A H, because each of the letters itself is complex and these three alone contain seven distinct lines.

When more material is given than can be perceived, it can be only vaguely described by the observer. From this we may draw the general conclusion that when more items are presented to view than the span of attention can accommodate, they are either vaguely seen as an indistinct experience or they are comprehended as a meaningful whole. Consequently, the way to increase the span of attention is to give material meaning.

There is a practical application of this principle in the field of advertising. A headline containing more than five words has been found to confuse rather than attract the attention of the reader. The same principle holds in the number of items in the advertisement. Most good advertising contains only a few major points but calls attention to these in a decisive way.

The span of attention in other senses than vision is not so easy to determine. It is very difficult for a person to distinguish the components of a tonal blend. In most cases one of the tones stands out dominantly and the others appear to change its quality. It is easier to distinguish successive tones than simultaneous ones. For example, it has been found that if a metronome is sounded at the rate of a beat every quarter of a second, eight successive taps can be distinguished without counting. This, however, is probably a measure of immediate memory span rather than a measure of the span of attention.

From these facts it follows that the man who learns to use his senses to the best advantage does so not by increasing the span of attention, not by increasing the number of discrete objects he can distinguish at any one time, but by training himself to give meaning to the different impressions.

XXII. Determinants of Attention

By attention we mean that certain elements of our experience are dominant in consciousness. We have seen that it is the result of competing elements, and that this competition results in a continual change in the element which is dominant. The question now arises as to what factors determine which elements shall gain the ascendency.

There are conditions within the individual himself which determine to which things he shall attend; these we shall call the *subjective determinants* of attention. There are other factors which relate more to the stimuli which impinge upon his sense organs; these we shall call the *objective determinants*. In isolating and studying the various determinants, we must remember that in actual life they do not function separately but always in very intricate combinations. We isolate them for purposes of exposition only.

The advertiser, or any one who does not have direct access to his audience, finds the objective determinants of attention of prime importance since he cannot control the subjective factors of those who read. He can, of course, make use of any general subjective factors, but he cannot make individual application of them. On the other hand one who can speak directly to a person can make use of the subjective factors to greater advantage than the objective factors. An orator can lead his audience up to a point where it will be receptive to his message, the sleight-of-hand performer can prepare his audience for his tricks, and the salesman can center the interest of his prospect on the goods to be sold. The value of any particular determinant must depend somewhat upon the purpose involved as well as upon the general setting.

Objective Determinants of Attention. 1. *An intense stimulus gains attention.* Other things being equal, an intense stimulus will attract the attention more effectively than a weak one. A loud sound, a bright color, a pungent odor, and a sharp pain all arouse and hold the attention better than milder stimuli of the same sort. The operation of this principle of intensity is not so simple, however, as it may seem to be at first glance. If a loud sound had only to compete with a fainter sound of the same quality, if a bright light had only to compete with a fainter light, and similarly with the other stimuli, the application would be simple. In reality, however, when a sound stimulus is given, it usually has to compete not only with other sounds of the same or different quality, but also with sights, tastes, odors, pains, and a vast number of other stimuli of all degrees of complexity. We have no way of comparing the intensity of a light with the intensity of a sound or an odor. Even if we could give equivalents in terms of physical energy, the comparison would not be accurate, for our organism might be better equipped to respond to one type of sensory stimulus than to another.

2. *The quality of the stimulus affects attention.* Experiments have shown that yellow is a better " attention-getter " than other colors of equal physical intensity; that is, there is something qualitative about yellow which attracts attention. Similarly, certain qualities of tones or tone combinations stand out over others which are physically more intense. This factor of quality should not be confused with meaning, which is a subjective condition to be considered later. There is something in

the very nature of certain stimuli themselves which make them striking to the observer.

In some instances what is usually considered quality may be the resultant of a peculiar combination of sensory impressions. This is doubtless true in the auditory realm and probably in others. A speaker with a relatively mild but pleasing voice may arrest the attention of an audience, whereas one with a blatant voice may fail.

3. *A large object attracts attention.* The size of the stimulus is related to attention. Because this is particularly true of visual stimuli, it has become an important consideration in advertising. The advertiser has to pay for his space and of course wants to utilize it to the fullest extent. His problem is to discover the size of advertisement which will give him maximum value. To be sure, attention is not the only consideration which determines the value of the size of an advertisement. As Poffenberger [1] points out, there are certain other conditions which tend to favor the larger advertisement. It is usually given the more favored position in an advertising medium. It eliminates competition. More money is spent to make it effective, because more money is paid for the space. Finally, the large advertisement gives the reader the impression that the advertiser is prospering, since he can afford to buy so much space; hence the reader is inclined to favor that product.

It is important for the advertiser to know the relative importance of the different factors which make size valuable. If it is thought that the whole value of size is its power to compel attention, the advertiser may merely buy large spaces, with little concern for what he puts in them. Hence, psychologists have made extended studies in an attempt to determine the relation of size to attention. After summing up this experimental evidence, Poffenberger concludes that " with increasing

[1] Poffenberger, A. T., *Psychology in Advertising*, pp. 175–176. Shaw, 1925.

size of space there does not go an increasing attention effect, but that the effect is about equal to the square root of the area."[1]

4. *Repetition of a stimulus attracts attention.* The first presentation of a stimulus may pass unnoticed, but if it is repeated several times, it will force itself into attention. There are many everyday illustrations of this. If some person in your presence raises his hand to rub his face or hair, you doubtless will not observe it, but if he does it several times you probably will notice it. Some persons make habitual grimaces which are very noticeable. These probably would pass unobserved, however, if they were made but once. It is their repetition which calls attention to them. For the same reason, the intermittent ringing of an alarm clock is more likely to waken a sleeper than continuous ringing.

There is a point, however, beyond which repetition ceases to be effective. If a stimulus is often repeated, we become accustomed to it, so that it no longer makes any appeal to attention. This is borne out by our experiences with the grimaces to which we have just referred. If you remain long in the company of a person who has one of these habit spasms, you soon will come to ignore it. If a faucet drips water it may be very annoying at first, but after a time you do not notice it any more than you notice the continuous ticking of the clock in the room.

We all recognize the advantage which comes from our ability to ignore an oft-repeated stimulus which has little significance for us. If repetition is to be effective, it must have continued or changing significance.

The power of repetition to attract attention has likewise received the consideration of advertisers because the advertiser has to pay for his use of repetition. That advertisers are convinced of the value of repetition is evidenced by the fact that

[1] Poffenberger, A. T., *Psychology in Advertising,* p. 194. Shaw, 1925.

advertisements are repeated over and over again. The problem is to discover the point of diminishing returns. Here again, however, the value of repetition does not lie wholly in its power to attract attention, but partly in its power to facilitate memory.

The study of the effect of repetitions of a stimulus on attention is a very complex one because it is closely bound up with other factors in attention and is influenced by the length of time between presentations. Results seem to indicate that succeeding presentations add to the attention-compelling value of the stimulus, but in decreasing amounts. The popular way to utilize the factor of repetition evidently is to launch an advertising campaign in which the appeal is made in various forms (introducing the factor of novelty or change); then after allowing an interval to elapse, to launch another campaign, usually of a somewhat different nature. Utilization of repetition to the best advantage depends upon the proper balance between it and monotony, because when repetition becomes monotonous, it is a stimulus to inattention rather than to attention.

5. *A novel stimulus attracts attention.* The object at the focus of consciousness, the one to which we are attending, has the most dominant influence on our reactions. When an item comes to our attention, we must respond to it in some manner. If it is something with which we are very familiar, we react in our customary manner and it ceases to occupy the focus. If it is not familiar, we cannot dispose of it so easily. It intrigues us, we wonder just what we should do about it, and it is this very uncertainty, this doubt on our part as to what we should do, which makes the object remain in the focus of attention.

We are all familiar with the operation of this principle. If a woman walks down the street wearing a hat of the fashion of 1776, or even of five years ago, she will attract a great deal of attention. The author was once attracted by a large crowd which had gathered on a city street. Upon investigating, he found that a man and woman had come in to see the sights, dressed in "Sunday clothes" of the last generation. This queerly dressed couple attracted the attention of the crowd more readily than the expensively decorated shop windows which had been designed for that purpose.

Of course we are interested primarily in the secondary results of attention. We want to attract attention, but if this is followed by ridicule or scorn it is ineffective from the practical standpoint. The shop-owners would not want to get the reaction from the crowd that this couple did. The problem confronting us in our several professions is to arouse interest which will end in a favorable reaction.

Common Factor in Objective Determinants of Attention. The effectiveness of some of the factors which we have been considering may be summed up in the one word *change*. *It is probable that change is the most effective stimulus to attention that we can discover.* This is simply another way of expressing the essential nature of attention which we have shown is the result of the competition of a vast number of stimuli to gain the focus of consciousness. If a certain stimulus, because of the balance of forces, is not changing very much, its relative position in attention is the same. If it changes rapidly, it has a relatively better chance of gaining attention.

The change, of course, is effective if it is from a mild intensity to a strong intensity, but it may be just as effective if it is in the other direction. For instance, if we are in a position where there is a continuous noise, we may come to ignore it. Let the noise suddenly stop and we immediately become aware of the change. It has been found that a person may have a hard time adjusting himself in a completely sound-proof room. He is ill at ease. He misses the noises about which he complained, and he cannot ignore their absence. An old miller used to start his grist mill and then go to sleep. As long as the din continued in its regular rhythm, he slept soundly. If it changed in the slightest, he was awake in an instant to see what was wrong or why the speed of the machinery had changed. Let the clock stop ticking and we notice it, whereas we did not know that it existed when it ticked in its accustomed manner. A telegraph-operator, seemingly oblivious to the clatter of the keys, is immediately attentive when his particular call comes in.

Interaction of Objective Determinants of Attention. In most instances when a stimulus attracts our attention it does so, not on account of the action of any one of the factors which we have enumerated, but because of a union of several. The successful advertiser does not depend solely upon magnitude, novelty, repetition, intensity, or change. He uses them all in varying combinations. Furthermore, the practical value of attracting attention is to gain a favorable response. If this is to be achieved, the determinants of attention must be so arranged that the response of the individual will be of the desirable sort. If the response is not of the desirable sort, it would have been better if the stimulus had not been brought to the attention of the individual. A good illustration of the futile arousal of attention is the device used by some shop-owners to draw the attention of pedestrians to the displays in their windows. They place the knocker of an electric bell so that it will strike on the shop window. This device gets the attention of those who pass, but if you watch their reactions, you will almost invariably see an expression of annoyance on their features. The store-keeper's object was to get purchasers but all he succeeded in doing was to annoy people. Roadside advertising which uses the word STOP printed in large letters to gain attention may have a similar effect. One is irritated when his attention is aroused if a suitable action on his part is not suggested at the same time.

Subjective Determinants of Attention. Of at least as great importance as the objective determinants of attention are the subjective determinants which favor or oppose any particular stimulus. The consideration of the subjective determinants has been much misunderstood because of our personal reaction toward them. We have a feeling that we can arbitrarily select the thing to which we shall attend and bend our energies toward that end. When, in spite of our seeming efforts, something else gains the focus, we feel it is because we have not exerted our energies to a sufficient degree. The common-sense notion of the development of attention has been to strive harder to attend, to bend all energies toward banishing the irrelevant ideas and favoring the relevant. Anyone who has tried this method will bear witness to its futility.

The subjective factors which favor attention may be summed up in one word, *interest,* a term which we shall presently analyze into its component parts. When we are interested in a subject, we do not need to force ourselves; we cannot help attending. Realizing this, some persons have tried to urge that we force ourselves to become interested. But we cannot develop interest by force; we must follow the principles upon which it operates. Interest is not static. It changes with age, with training, with emotional patterns, and with every experience of life. Consequently, our study of the subjective factors in attention will be a study of the manner in which certain types of stimuli become welcome or interesting to the individual.

1. *Some stimuli are natively more interesting than others.* The child responds more readily to a loud sound, a bright light, or a sharp pain than he does to a symphony, a beautiful painting, or an eloquent speech. He is equipped to respond to intense sensory stimuli but, since they have little or no meaning to him, his reactions are largely proportional to their intensity. Because his responses are unorganized, his reactions are usually

short lived. Consequently, he responds first to one impression and then to another. In other words, he is distractable. Distractability is merely the result of the fact that all his impressions have equal subjective value. His interests are vague and fleeting because his impressions are vague and his responses random. To make a situation interesting to the young child, one must make the stimulus striking. It is futile to chide a child for lack of interest and inability to attend. Rather, one must arouse his interest by giving him stimuli adequate to challenge his reactions. His interest may be aroused by teaching him the significance of specific situations and not by moralizing about the value of interest as such. The same principle holds with reference to adult interests. If an adult will not attend to a particular stimulus, it is because that situation has little or no meaning to him.

2. *Meaning stimulates interest.* We shall find when we come to study perception that meanings are acquired by repeated and varying responses to similar situations. A person's response may be inadequate or it may even appear wrong to another person, but it nevertheless has meaning for the one making the response. Meaning is then nothing but familiarity. If a person listens to a symphony orchestra playing a new selection, he may derive pleasure from the music from the very start, but that pleasure is accentuated and his interest quickened by the recognition of the dominant strain appearing in different harmonic relationships throughout the selection. Show a book to a little child who cannot read, and the printed page will have no interest at all. If he is old enough to get the significance from pictures, he wants to leaf through the book to find the pictures. If he is too young for the pictures to have meaning, he will want to tear the book in order to hear the paper rattle and tear. In the latter instance, rattling and tearing are the meaningful experiences, in the former, the pictures are. In later life the printing furnishes the material which is most in-

teresting. Childhood interests often persist and color adult interests. We are probably all interested in hearing paper tear and rattle, but we have inhibited gratification of this interest because it is destructive and because we have probably been punished for conduct of this sort. We all still enjoy looking at the pictures in a book. Hence the interests of the adult are not so vitally different from those of the child; they are merely more complex because experiences have given them more meaning.

3. *Uncertainty stimulates interest.* If we know a thing too well, it is likely to lack interest. If, on the other hand, we are confronted with a situation in which we do not know just how to respond, our interest is stimulated. There must be just enough uncertainty to arouse a little fear of results. This is one reason why football and other games are so interesting. If the fear element is too pronounced, the interest may turn into a tendency to retreat from the situation. There must be enough meaning in it to enable us to guess what we shall do.

If you wish to destroy the interest of a book, read the last chapter first or get someone who has read it to tell you how it turns out. Persons sometimes express a wish to foresee what the future holds for them, but few of us really want this power if it could be granted. The spice of life is the uncertainty of the future. If the uncertainty were removed, there would be no thrill in speculating about it.

An executive who has men in his charge must utilize this characteristic of human nature if he intends to keep his men attentive to their work. All work tends to become monotonous and uninteresting. It is because the things which are ahead are uncertain and because the men feel that in some vague way the present labor is leading them on to the mysterious future that they are intent on continuing the work. If men are in a constant state of fear lest they lose their jobs, they will not work well; but, on the other hand, if they see nothing better ahead, they will become indifferent. The wise administrator is the one who can get a balance between the two.

The story is told that Mr. Schwab came into one of his plants one morning and placed a number in a conspicuous place on the wall. The men did not know what the number meant, but they were all immediately interested and curious to learn its significance. The talk all centered around this queer performance on the part of Mr. Schwab. The next morning he came in and placed before them another number in the same mysterious manner. After a time it was discovered that he was doing the same thing in other plants and that the numbers represented the relative efficiency of the different plants. The resultant competition to make a better efficiency score was much more effective because of the initial interest aroused by this method than it would have been if he had presented his plan in a more formal and less striking manner.

4. *Emotional habits determine interest.* When a situation first attracts our attention, it is due to a combination of external and internal conditions which may be the result of pure chance. As a result of our first response, meaning is derived and our emotional reaction to the total situation may be pleasant or unpleasant. If the emotional reaction is of a favorable sort, there follows a tendency to favor that situation and to investigate details. This adds still more meaning, fosters a still more favorable emotional attitude, and gives a stronger impetus to attend to things related to the situation.

Many of our likes and dislikes for certain foods are based on this factor. A boy who became nauseated from eating too much cheese became so thoroughly affected that he could eat no cheese for the remainder of his life. One child may dislike cod-liver oil and another may like it merely because of the way in which it was given to them in their early childhood. The foods fads of adults and the intensity with which they adhere to their likes and dislikes bear constant testimony to the permanence of emotional interests.

Many a permanent professional interest is built up in this manner. A boy may become interested in a stone because of some chance circumstance. If some person happens to be near who knows something about geology and explains the reason why the stone appears as it does, the scope of the boy's interest is widened, and he tends to become interested in other stones. More details are added, additional emotional patterns are established, and the boy may develop a permanent interest in geology. If, on the other hand, this first interest leads to unpleasant emotional experiences — if he is forced to memorize a dozen long names and pass a hard examination, if he gets a reprimand from his mother for getting his clothes dirty, or if he falls off a cliff while trying to get the stone and is seriously hurt — he may develop a positive dislike for geology.

If the professional man could trace his interest in his profession, he would be likely to find that it was initiated in some trivial experience, later followed by others, which aroused his curiosity in the subject matter of that profession and furnished the drive for continued interest and enthusiasm. A physician should not have to force himself to be interested in his work and to attend to its details. If he does, something was lacking in his introduction to his profession or in some later experience in connection with it. The reason an outsider cannot understand why a chemist will spend hours in a laboratory working with uninteresting test tubes is that he does not know the experiences which are back of that interest or the hopes for the future that inspire it.

All this points to the conclusion that attempts to force the attention of a child upon some subject are futile. Forcing is likely to develop an antagonism which will persist indefinitely. A good illustration of the ineffectiveness of this method is found in the old way of teaching arithmetic to children. It is well known that college students hate mathematics and the majority of those who take it do so only because it is required for graduation. There is no inherent reason why mathematics should be more uninteresting than any other study. But after seeing how it is taught in most schools, one does not need to seek further to know why it is disliked. A child is set to work memorizing tables and solving problems which have no meaning for him and is made to suffer if his attention wanders. Not a single one of the principles of interest and attention that we have enumerated is followed. If the lawyer, physician, dentist, minister, or any other professional man had been introduced into his profession as most children are introduced to mathematics, how much success would he have? Unfortunately, there are professional men who do react to their professions in just this manner.

Continued attention to any general subject or to any professional activity is based on the development of a favorable emotional attitude toward it. This attitude will tend to make the person respond with interest and, as a consequence, attend to details whenever anything related to that subject is presented. Watch the man who is truly interested in art viewing a beautiful scene, or the man who is interested in music listening to beautiful music, if you wish to see the compelling force of a dominant interest. Such a person does not have to ask how he can make himself attend to his work.

XXIII. Adjustments which Facilitate Attention

With attention there is likely to be an adjustment of the sense organs so that the stimulus may become clearer. But attention is not merely sensory clearness and an inner attitude; it is a response. Attention responses may be divided roughly, according to degree, into incipient movements, emotional reactions, and logical reactions.

Adjustment of Sense Organs in Attention. A sensory stimulus may be present and at the same time be totally ignored if our attention is centered elsewhere. A common illustration of this is the case of a boy who, tremendously interested in the game he is playing, hurts his hand. He may continue with his play for a considerable period of time without knowing that he has injured himself. After the excitement of the game is over, he suddenly senses a pain in his hand and sees that it is covered with blood. Immediately the pain becomes very intense and he suffers keenly. Once the impression comes to the focus of consciousness, there is a tendency for the sense organ to adjust more accurately so that the sensory impression may become clearer.

An illustration of this sensory adjustment can be found in the field of vision. If the eye is fixated on a particular point, one can also get impressions on the periphery of the retina from adjacent points. These peripheral stimulations are usually not so clear as those from the fovea. However, without changing the fixation point of the eyes, one can see the objects on the periphery more clearly merely by focusing attention on them. When this is first attempted, there is an almost irresistible impulse to turn the eyes so that the object of attention will be brought to the fovea where it may be seen more clearly. In other words the sense organ tends to adjust so that the object of attention may be focused where it can make the greatest impression. However, even if this attempt is blocked, the attention may still be directed to the vague peripheral object, which becomes relatively clearer through the mere shift of attention.

The fact that the adjustment of the sense organs is vital in the attentive process should be considered when an attempt is made to secure and maintain the attention of an auditor or a reader. We all know how hard it is to pay continuous attention to a speaker whom we cannot hear distinctly. As fatigue causes our bodily tension to relax, our attention wanders even though the subject matter may be relatively interesting. Advertisers would do well to make the dominant message of their advertisements appeal to the types of sensory adjustments which are easily made. The attention should be directed to the important feature of the advertisement by means of an illustration or by the arrangement of type or lines, and then the sensory adjustment encouraged to follow a definite course which will bring the whole message to the reader in the most forceful manner. The whole experience should leave the reader with a pleasant emotional attitude, so that a similar appeal at a future time will immediately arrest his attention again. If his attention is attracted and a state of unpleasant tension results, he is likely to inhibit a response to a similar message in the future.

Motor Adjustments in Attention. Attention is not only awareness, it is a response. Man is a living organism, responding at all times to the situations in which he finds himself. Our description of attention is merely another way of saying that man selects specific features of his environment to which to respond. He responds most forcibly to the dominant feature, the one which has come to the focus of attention; but also, in a less pronounced degree in most instances, he responds to other things which may not be at the focus. He responds to the whole pattern of stimuli which impinge upon his sense organs.

It is obvious from this that the attentive process involves motor adjustments. When one attends to a visual stimulus, he makes either actual overt responses or incipient responses to what he sees. The same may be said of the responses to other sensory stimuli.

There are various orders of motor response. One type is merely the projection of oneself into the situation confronted. A man who clenches his fists when he sees a picture of a fight illustrates this type of response. One who articulates as he reads is another example. These persons tend, in incipient movements, to act a part in the situations to which they are attending.

Another type of motor response is emotional abandon. A person may gaze at a work of art and permit himself to be carried away by it. The difference between a person of this and of the previous type may be seen in the different manner in which each might react to a musical selection. The person of the first type may keep time with his hand or foot or hum the melody; the person of the second type might do neither, but instead, relax and permit himself to be charmed by the emotional effects.

A third type of motor adjustment in attention is the result of a more or less logical analysis of the situation. This last type is the one generally considered most desirable. It does not preclude the first two, however. If we speak to a person, we do not wish his response to be a mere utterance of articulate sounds. We want a logical response, a definite reaction to our verbal message. We look for evidences of projection and of the emotional response as we proceed with our message in order to see whether it is understood, but a reaction to what we say is what is desired.

The significance of adequate motor response in attention is illustrated by the following incident. A teacher had labored to get a boy in her class to attend to her instruction. He was continually inattentive. Finally, one day as she talked, he looked directly at her (evidence of adequate sensory adjustment); as she talked his lips and jaw showed incipient movements (evidence of the first type of motor adjustment); and his face seemed to glow with pleasure (evidence of an emotional response). The teacher accepted these signs as an indication that he was attending to her message. When she had finished, she sought to elicit the third type of motor response, which would indicate that the boy had made a logical analysis of what she had said, by asking him a question. She was amazed to hear him reply, "It is only your *lower* jaw moves when you talk, isn't it?" The boy had attended, and had even logically analyzed and adequately reacted to the subject matter of his attention, but the teacher had been deceived as to the center of his interest.

The salesman or any other person who has to influence others must learn to interpret from the expressive activity of a person whether he is attending and to what he is attending. He must be unobtrusive himself if he wants the customer to attend to his message. Many a good sales talk has been diverted from its logical effectiveness because the salesman had a gold tooth which dominated the attention of his prospective buyer. If a person cannot hear what you say because he has to look at how you are dressed, or how you comb your hair, or how you wrinkle your nose when you talk, your message is liable to be lost.

Think of the persons who have impressed you during the day. What was it that stood out? Was it the cosmetics, the perfume, the clothing, the quality of the voice, or the things that were said or done? After you have made this analysis, you might make a comparison and determine to some extent what it is about yourself that attracts attention, and whether or not the results of such attention are likely to be favorable.

XXIV. Making Attention Function Effectively

In this section we shall study some practical applications of the principles we have been considering. Some pertinent questions are: How can distraction be avoided? How can attention be kept active? How can we keep our attention on a specific subject? How can we hold or divert the attention of others? How can attention be turned from unpleasant subjects? How can we guide the movements of attention?

Practical Hints in the Control of Attention. The control of attention, both in ourselves and in others, presents a number of problems.

1. *How can distractions be overcome?* A practical consideration in the study of attention is the discovery of means of controlling the subjective determinants so that external determinants may be overruled. When one tries to attend to the study of a lesson, his attention may be diverted by the music he hears from an adjoining house or by some other irrelevant sensory stimulus. How can one overcome these external stimuli so that he can continue with his studies? Or one may be distracted with ideas which press forward and occupy the focus of consciousness. How can one keep the thoughts of his plans for the evening, or the unpleasant thoughts connected with the death of a dear friend, or similar insistent ideas from crowding out interest in his work?

It has been almost universally assumed that distractions are inimical to attention, and that if we could determine the amount of distraction necessary to interfere with attention under various conditions, we should have a measure of the strength of attention possessed by a person. Consequently, experiments have been devised to introduce distractions while a person is occupied with some task. These experiments have not corroborated the theory. What actually happens when a distracting situation is introduced is that the person is momentarily disturbed; but in a short time he overcomes this disturbing influence, is actually stimulated by it to do better work, and continues in a state of increased tension and productivity until the disturbance is removed; whereupon he relaxes and does somewhat less efficient work. These experiments seem to indicate that distraction incites the worker to greater tension in his attempt to overcome the distraction. If the worker did not care whether he accomplished anything, the results might not be the same. The boy in the school room who does not want to study does not attempt to fight the distracting influence of the noise of the circus parade passing the window. Certainly such a distraction would not increase his productivity. He would welcome the chance to stop studying for a time.

If resistance to a distraction is successful, it is accomplished by positive and not by negative methods. If, when one hears a disturbing noise, he directs his attention to overcoming its influence, he is thereby paying attention to it, albeit in a negative manner. By saying continually, " I will not listen, I will not listen, I will not listen," he is effectively keeping the noise at the focus of attention. The same thing obtains when trying to resist ideational distraction. To say, " I will not think of that horrible scene, I will not think of it, I will not think of it," is merely reminding oneself of it. The way to get rid of an unpleasant idea is to get a stronger, more interesting one to take its place.

2. *How can attention be kept active?* Alertness is a fundamental requisite of modern life. We must be aware of the varying conditions in our environment, respond to each situation as it arises, and be prepared to change our type of response with each change in our surroundings. If our work is so uninteresting that we cannot keep alert, it may pay us to analyze it and consider whether there is not some way of enlivening it. Often we can rearrange our work so that it takes on a new appearance. The very question as to whether there is not some better way to do the work will be a stimulant. Many inventions of great use to man were devised because some intelligent person began to question the wisdom of continuing in the same monotonous manner an extremely boresome task. A question stimulates interest. " Why should I be doing this in this manner? " " Is there not an easier way to do it? " Such questions will sharpen one's interest and stimulate his attention.

3. *How can attention be kept on a specific subject?* One can keep his attention on a given task by continually searching for new details and new meanings in relation to the subject matter in hand. When we have exhausted the novelty in a subject, our attention may wander and some new item of a different sort will come in to claim the focus. But when is a subject exhausted? There are infinite possibilities in any subject if one only searches for them. It is only when we begin to know something about a subject that we realize how great a field for exploration remains. It is only the ignorant, complacent egoist who thinks he has exhausted any subject which confronts him.

4. *How can I hold the attention of another?* Getting the attention of another is absolutely essential before you can influence him in any particular. If you wish to inspire a group of persons, you must in some way get their attention centered upon the point at issue; you must arouse their interest in your appeal so that they adopt a receptive attitude toward your presentation. Whether your appeal is written or oral the principles are the same. In the first place you can study the individual or group of individuals and determine their subjective interests. By appealing to these, you will be more likely to secure the subjective support of attention. You can also arrange your communications so that the objective factors will follow the natural laws of attention. Keep ever presenting new aspects of your subject so that it has the continual appeal of novelty, interest, and meaning for your audience. If you are speaking, you can determine the effects of your appeal as you proceed and can modify your speech so as to carry your hearer from one point of interest to another. In brief, you hold the attention of another by studying him, not by studying yourself or your technique of presentation, except as you attempt to adapt it to his responses.

These principles are illustrated by the good life-insurance salesman. Before such a salesman approaches you, he finds out all he can about you. He learns about your work and your income, your professional and social interests, and whether there are any persons dependent upon you. After finding out how much insurance you now carry, he is in a position to work out a proposed budget for additional insurance. After doing this he is prepared for his first interview. This may be brief and have little or nothing to do with insurance. In later interviews, during which he continues his efforts to interest you, he may sell you insurance. His success as a salesman is largely a measure of his success in interesting you.

5. *How can I divert my attention from an unpleasant subject?* The attempt to force a subject from attention is always futile. It can be banished only by achieving a more intense interest in some other subject. If this is impossible because of the intense emotional appeal of the undesirable subject, then the best method may be to let the unpleasant subject have control until by sheer familiarity it passes out of the focus. This method may cause some unhappiness, but the results are worth the cost.

6. *How can I divert the attention of another?* The attention of another is diverted by the same methods as are effective in directing one's own attention. Precaution must be taken that the person does not perceive what is being attempted. The sleight-of-hand performer is a past master at diverting the attention of his audience. While his audience is watching him do one thing, he is doing something else which they do not perceive. How different his technique from the crude methods adults sometimes try with children! How absurd to admonish a child in this manner: "Now let us forget you want some candy and let us talk of your school work."

7. *How can I guide the movements of attention?* In all attempts to control attention, remember that it cannot be forced into static molds. It is continually shifting and the only con-

trol that can be exercised must be in relation to the direction of the shifts. Concentrate your efforts on steering, not on applying the brakes. Steering may not always take the direction which appears most logical, but the direction must be determined in relation to interest. Be guided by interest and the task will be easy.

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CHAPTER VI

PERCEPTION

XXV. The Nature of Perception

Perception is the process of giving immediate meaning to sensory experiences. Meaning is the result of the stimuli one has received and the way one has responded to them. It is also dependent upon temporary influences arising from one's immediate surroundings. Perceptions are as complex as life itself.

Perception Is Meaning. It is not enough for a person to have sensory awareness of what is going on around him. Things and happenings must have meaning if one is to adjust intelligently to them. As I look at a printed page I am not merely seeing black and white; I am seeing printed symbols — words — which have certain significances. If they had no significance, they would be merely a blur. The richness of our lives is directly related to the meaning that we give to our experiences. To one unversed in music a symphony concert may be a mere jumble of sounds; to the orchestra leader each sound in the whole ensemble has significance. *The process of giving immediate meaning to our sensory experiences is called perception.* It will be our task in this chapter to study the manner in which perception develops and the various forms it assumes in an individual's mental organization.

Varied Interpretations of Similar Experiences. A man's life is rich or poor in proportion to the richness or poorness of his perceptual processes. One man will take a trip through a city and see a large number of things which fit into the background of his experience. Later he can tell you a great deal about his trip. Another man, covering exactly the same territory, will know practically nothing about what he saw or heard. Furthermore, the class of things that have meaning will vary with each person according to the specialized experiences of each. The psychologist riding in a passenger coach sees his fellow passengers as so many persons with various traits manifesting themselves in different types of conduct. The tailor riding in the same coach interprets his experiences in terms of clothing. The suspicious, nonsocial person sees so many potential enemies. The conductor sees so many passengers, the vendor so many hungry or restless animals, the physician so many possible patients, and the porter so many sources of tips.

From this illustration it should be clear that we do not react to sensations as such; that is, to lights, colors, sounds, tastes, smells, contacts, and the like. We react to these sensations according to the way in which they represent to us concrete, meaningful situations. If a stimulus which has no significance impinges upon our sense organs, the only way in which we may react is in random fashion. It is quite likely that a large part of an infant's reactions are of this sort. He hears a loud sound and may jump, throw up his arms, kick his legs, and even utter a cry. The sound is merely a stimulus to arouse him to activity, but the nature of the situation producing the sound or the utility of his reactions has no meaning for him. How does it get meaning?

Perceptions Result from Experiences. Perceptual meanings come as the result of actual responses to stimuli. If, at the same time that the infant hears a particular sound, he feels a pain in his foot, the sound will become a part of an experience in which he felt pain in his foot. If the pain does not come until after he has made a certain movement with his leg, then the sequence will be: sound — kick — pain. If the next time he hears this sound he makes another sort of movement and does not feel the pain, the sequence may be: sound — incipient kick — second movement — freedom from pain. The meaning is still very vague in such a situation, but probably a large part of the child's environment is vague. What meaning his environment does have, however, furnishes the pattern for more complex perceptual meanings. A baby does not react intelligently to his first sensory experiences from a milk bottle because he has had no experience with a bottle. He sees certain lights and colors, he sees a change in these lights and colors as the bottle is moved closer to him, he gets tactual impressions as the nipple is placed to his lips, and gustatory impressions when the milk flows into his mouth. He reaches out with his hands and feels the bottle and moves it around. Each type of contact enriches his meanings in reference to the bottle. He gets acquainted with his bottle by uniting the impressions from different sense organs with the various reactions that he makes, and the whole situation gives him an experiential background for future perceptions.

Upon repetition such a series of contacts with the bottle becomes more than a group of sensory impressions; they develop into a unified experience, each section of which is an integral part of the whole. This unification of related sensations and responses is what we mean by perception. The child with a background of such experience begins to react as he did in previous situations as soon as he experiences any sensation or combination of sensations which seem to be a revival of the past situation. For example, he may get the visual sensations alone. Without the contact, taste, or manipulation of the bottle, he may begin to go through sucking movements and the saliva may come to his mouth. The visual sensations have set off the reactions he made in the composite previous experience. They act as a cue, a signal for action.

This factor indicates the economical value of perception. If through experience such unification did not take place, each situation would have to be explored and tested anew. As it is, we begin to act on the merest suggestion that this situation is like a previous one. This tendency has its dangers as well as its advantages. One may make a mistake and interpret the present situation incorrectly. The perceptually efficient man is the one who quickly identifies the perceptual cues in each situation, and successfully interprets and acts upon them. The perceptually inefficient man is he who makes incorrect inferences, which result in inadequate or incorrect reactions. No one can make an accurate interpretation of every situation immediately. A person must respond tentatively, accept quickly the evidence that he was either correct or in error, and, if the latter is the case, readjust his interpretation and respond differently. Obviously, the man who is continually confronted by new situations cannot always be right. He must make mistakes and rectify them. The man who boasts that he is never wrong perceptually must be one who is in such a rut that he never takes cognizance of anything new in life.

The primary factor in perception is thus seen to be experience. Wide and varied experiences make for rich perceptions; limited and monotonous experiences restrict perceptual life. Memory — that is, in the broad sense of any modification of the nervous system which is retained — is therefore the basis of perception.

Influence of Temporary Set on Perception. A person may interpret and react to the same situation in different ways, depending upon the attitude or set with which he approaches the situation. This set may be the direct result of preceding external situations or of some definite internal experience; or it may be due to incidental factors in the situation itself; that is, to the context.

1. *Context.* Let us illustrate the effect of context first. If in broad daylight, with different persons moving about the house, talking, whistling, and singing, you should hear a floor board creak, you would be likely to ignore it completely; or,

if you heard it, you would be likely to interpret it as the creaking of the floor. Suppose that the same sound is heard in the dead of the night. You may hear it as the approach of a burglar. In the light of this interpretation, your heart will beat faster and you will hold your breath as you listen for the next sound. The small boy walking with his father will see the shadows of trees on a moonlight night as shadows and be unafraid. Let him see the same shadows while walking alone through a cemetery, and they become horrible specters. A salesman will have quite a different reaction toward a prospective customer if he approaches him in his elaborately furnished office, sitting behind a formidable desk, from the reaction he will have if he meets him on the golf course. It is well known that a man is much more likely to react favorably to a suggestion if it is presented to him after he has finished an excellent meal served in a spacious dining room to the accompaniment of fine music, and followed by a good cigar. Under such circumstances a proposition looks very different from what it would if the same man, suffering from dyspepsia, was approached in his office when his desk was piled high with distasteful and unfinished work. A garment will look gorgeous if displayed in fine surroundings, but if it is placed in the bargain basement it looks tawdry.

2. *Contrast.* On the other hand, the local setting may furnish to a particular object a peculiar advantage due to contrast. A tall man looks taller when he is with a small companion. A dollar has a different value for the pauper from what it has for the millionaire. The sunshine appears particularly bright after a series of cloudy days.

This principle is important in selling. If you wish to sell a new car, let the prospective buyer see his own car in comparison with a bright new one. The newness of the latest model will make a car with which he was fairly well satisfied look remarkably shabby. A salesman may sell a very high-grade piece of goods if he will display a piece of very poor quality beside the finer piece. On the other hand, if he showed a graded series, the buyer might quickly pick one in the middle of the series because contrast would not be effective in this latter situation.

The fact that all our judgments are relative was clearly demonstrated in the production of a motion picture. It was desired to show Mary Pickford at various ages through the picture. Although it was not possible to photograph the star when she was a small girl and again at various stages of growth, the same effect was secured by changing the size of the furniture in the settings. When surrounded by big furniture, Miss Pickford was judged to be small; surrounded by small furniture, she appeared to be grown.

3. *Preparatory events.* The events leading up to a perception are equally important in determining the attitude which the observer may take toward it. A great many jokes are based on this principle. By preliminary statements the hearer is prepared for one thing which is suddenly turned off in another direction. Most mechanical puzzles owe their virtue to the fact that they suggest to one a solution which is ineffective. Physicians have more success with their patients when they can inspire in them a feeling of confidence. A certain attitude toward a situation may be induced by clever manipulation of the events leading up to the situation.

XXVI. Perception in Daily Life

If we recognize the fact that each individual can interpret life only in terms of his own experiences, we then have a better understanding of the person whose point of view is different from our own. We should not expect others to give the same meaning to situations as we do. Some persons are rather slow in seeing the significance of a new situation, while others, because of their ability to perceive faint cues, seem uncanny in their insight. If we can interpret the faint cues that others give through their behavior, we have the basis of social control in our dealings not only with individuals but also with large groups.

Perceptions Are Individual Interpretations. Our analysis of the development of perceptions indicates that perceptions depend upon individual experience; hence each perception is an individual thing. We perceive things similarly only in so far as our experiences have been the same. Since each person has a life experience different from every other person, no two persons perceive their environment in exactly the same manner. This is a very important principle to keep in mind, for if we do not expect others to react to life's experiences just as we do, we are less likely to be intolerant. The assertion that each man has a right to his own interpretation of life is sound, for it is based on this principle of the individuality of perceptions. Woodworth has expressed this principle very clearly in his statement: "We see things not as they are but as we are."

FIG. 36. WHAT DOES THIS FIGURE REPRESENT?

There is an experiment in psychology used to demonstrate this principle. Show to a number of persons a complicated ink blot, such as the one given in Figure 36, and ask them, "What might this be?" One person may see it as a bat, another as two animals fighting, another as an anatomical specimen, another as a ship with spread sails, and so on. The person's individual set will determine what he sees. The same principle holds in crystal gazing. When one gazes into a crystal, there is a play of lights which may be interpreted in any manner congenial to the gazer. What one sees in a crystal is a reflection of the perceptual set of the one gazing into it, not the future, as charlatans try to tell us.

What may appear to be pure reasoning is often colored by our individual perceptions. Many of our arguments are futile because they are simply attempts to defend our own perception of things against another's perception of the same things. If we could see things through the other's perceptual set, there would be no argument. Consequently, when we attempt to convince another of the truth of our position, we must change his manner of looking at it to correspond to our own before we can expect him to agree that we are right. This principle is illustrated by the story of the six blind men of Indostan who went to see an elephant. The following paraphrase of the poem shows how the perception of each man varied from that of the others because of their different experiences.

First blind man, falling against the elephant's side:
  "God bless me! but this elephant is very like a wall."
Second blind man, feeling the tusk:
  "This wonder of an elephant is very like a spear."
Third blind man, grasping the squirming trunk:
  "I see," quoth he, "the elephant is very like a snake."
Fourth blind man, clasping the knee:
  "'Tis clear enough, the elephant is very like a tree."
Fifth blind man, catching the ear:
  "This marvel of an elephant is very like a fan."
Sixth blind man, seizing the swinging tail:
  "I see," quoth he, "the elephant is very like a rope."

And so these men of Indostan
  Disputed loud and long,
Each in his own opinion
  Exceeding stiff and strong,
Though each was partly in the right,
  And all were in the wrong.

Each man's interpretation of life is correct because he interprets his own experiences. But his experiences may be inadequate. The way to change his views is to enrich his experience. Study where his perceptions are lacking, furnish him the experiences that will fill in these gaps, and you have won the argument.

The Basis of Extraordinary Insight. A person may often be unaware of the particular part of his perceptual experience that governs his interpretation. He may think it is some obvious factor, whereas it is often some minor element in the situation. There is a tendency on the part of some persons to believe that they have a special faculty for interpreting life — a faculty which they call intuition. When intuition is analyzed, it is found to be nothing but the ability to take minor factors into consideration and to act upon them without recognizing them as the reasons for the response. When the response proves to be correct, the person cannot tell just why he acted but, having acted correctly, he is led to believe he has some peculiar faculty not possessed by others. Intuition involves also the willingness to take a chance. Some persons are not willing to act until they are certain they are right. The person who acts intuitively takes the " gambler's chance " and acts upon minimal cues.

The performance of so-called mind readers can be explained in the same way. The mind reader asks you to hide something while he is absent; then, by taking the hand of some person who knows where the object is hidden, he will go to it. The person whose hand he grasps has been found to make very weak muscular responses which the " reader " is able to interpret and by means of which he is led to the object. It is the same principle as though the group should shout as the person hunts: " Cold — hot — colder — warm — hot — very hot." Although the responses of the muscles are not so obvious a cue as the cries are, nevertheless their meaning is just as clear to one who has trained himself to perceive them.

The tricks of trained animals can be explained by the same principle. For example, the Elberfeld horses were supposed to have the ability to do sums, extract square roots, and do similar problems that were placed before them on a blackboard. They would tap out their responses, appearing to solve the problems independently. It was found, however, that the taps were responses to slight and unintentional movements on the part of some one present who knew the answer. When there was no one present who knew the answer, the animals were unable to solve the problems.

Perception of Significance in Interpreting Others' Conduct. Success in social contacts is dependent largely upon the accurate observation and interpretation of the reactions of others. The good poker-player is the one who can read the emotions of his opponent in spite of all his efforts to hide them. These emotions are manifested in little muscular tensions and twitchings of the face, hands, or body.

In many practical situations the value of interpreting such signs is apparent. The salesman must be able to tell just how his customer is reacting to his sales talk and adjust his approach accordingly. Many a sale has been lost because the salesman tried to get his customer to " sign " too quickly. The public speaker has to do this same thing on a broader scale. He can tell whether his audience is following him or not, and he adjusts his speech to the responses he receives from the audience — not visible applause or hisses, but the tiny reactions which the inexperienced speaker might be totally unable to see.

Morale. Probably in no situation are the factors of context, the preliminary setting, and the creation by these means of a proper attitude more strikingly demonstrated than in group morale. By morale is meant a group spirit which unites each member of the group in the achievement of a common end.

The manner in which a person is introduced to a situation may color his whole attitude toward that situation for years. Ever after he may see it in terms of his first experiences. This was well illustrated by the manner in which civilians were introduced into the army during the World War. At first they were received gruffly, given poor food and ill-fitting clothing, and put to work at distasteful drills. It was found that these men maintained a disgruntled attitude throughout their service. To overcome this condition, a new plan was adopted. The recruits were received at the station with a band, were taken to the dining hall and given a hearty meal, a " pep session " was held, and after a fine shower, they were given good beds. These men woke up the next morning with a bright outlook on life and thought army life was a fine thing.

Industrial organizations are learning to do the same thing. Many companies conduct each new man through the entire plant, showing him the whole process of manufacture, assembly, and distribution of goods. He is made to feel that he is a part of a great organization. In other words, the perceptual interpretation is enriched. What otherwise would be an unpleasant confusion and jumble acquires meaning, and this meaning makes for an intelligent attitude toward the particular work of the individual.

XXVII. Perception of Space

If we are to react successfully to the environment in which we live, we must gain some conception of spatial arrangements, the distance of various objects from us, their relative size, and their relations to each other in space. Knowledge of these spatial relationships must be learned by individual experience. Needless to say, the newborn child does not know the qualities of the objects in his environment but must learn them by experience. How does he learn these spatial qualities of his environment?

There is little doubt that the various sense organs coöperate in the acquisition of this knowledge. Cutaneous, auditory, kinæsthetic, static, and visual perceptions all play their part. Of these, the cutaneous and visual perceptions are the most important. Perception of auditory space is very inaccurate and the kinæsthetic and static sensations play but minor parts in the perception of space. We shall, consequently, emphasize the cutaneous, or tactile, factors and the visual factors.

The Growth of Space Perception. Our knowledge of spatial relations is primarily acquired through movement of one sort or another. We pass our hands over objects; we reach from one object to another; we walk from one place to another and learn distances by so doing; we move our eyes from one part of an object to another part, and from one object to another, and relate these movements of our eyes to movements of other parts of our body. By coördinating all these into various combinations, we come to learn something about spatial values. It is commonly known that the child makes gross errors in his exploratory movements. He will reach for the moon, will make all sorts of errors in grasping for his ball or bottle. He will bump his head, arms, and legs violently against objects because he does not accurately perceive their distance. But by all these errors he is learning about his spatial environment.

In the course of learning he is receiving impressions from different sense fields which are often contradictory, and he must continually correct these impressions. Indeed, even in adult life there is great disparity in our judgment of spatial relations as perceived under different conditions. There is, for example, great disparity between the size of a cavity in a tooth as felt by the tongue and as felt by the finger tip or seen by the eye. An object appears to be smaller when seen at the periphery of the eye than when seen at the fovea. The edge of a card pressed gently upon the forearm will feel shorter than it looks. If the finger tips are passed slowly along the edge of the card, it will feel longer than it looks to the eye. Such illustrations indicate to us the difficulties the child must encounter when learning space relations, and yet, in spite of these conflicting experiences, he comes to have a fairly reliable notion of spatial relationships.

Tactual Space. All parts of the skin are not equally sensitive. This can be readily tested by measuring on different parts of the body the distance by which two points must be separated in order to be perceived as two. Table V indicates, in millimeters, what these distances may be in a normal person.

TABLE V. TYPICAL DIFFERENCES IN TWO-POINT THRESHOLD FOR VARIOUS PARTS OF THE BODY

Part of Body	*mm.*
Tip of tongue	1
Undersurface of third phalanx of finger	2
Red part of lip	4
Tip of nose	6
Ball of thumb	6
Center of palm	8
Eyelid	11
Cheek	15
Temples	22
Back of head	27
Back of hand	31
Knee	36
Neck	54
Center of back	67

From Table V it is obvious that we must learn to relate the tactile impressions received from an object to the part of the body with which it comes in contact. Our most accurate knowledge comes from those parts in which the ability to discriminate is greatest. These sensitive parts are roughly related to the degree of mobility of the part. The finger tip is more mobile than the center of the back; hence, if we want to learn the size of a new object, we gain more knowledge by touching it with our finger tips than by pressing it against our backs.

Visual Space. Visual perceptions are the most important in our adjustment to spatial objects. To realize this, we need only to observe a blind man attempting to get about. He must listen carefully for all possible sounds, and use his cane to feel for objects around him. If he can orient himself at all with these cues, we feel that he deserves great credit for his achievement.

The various visual factors combine in very intricate ways to give us our total perception of spatial elements, but for purposes of exposition it may be well to consider them separately. They can for convenience be divided into two main groups: (*a*) monocular factors — those which depend upon the use of but one eye, and (*b*) binocular factors — those which depend upon the combined use of the two eyes.

Monocular Factors. The monocular factors that may be distinguished are: (1) clearness of outline, (2) superposition, (3) shadows and shading, (4) the size of familiar objects, (5) the shape of familiar objects, and (6) relative motion.

1. *Clearness of outline.* In our experience with various objects we learn that *when something is close to our eyes it is seen* more clearly in outline than when it is at a distance. Clearness consequently suggests closeness, and dimness suggests remoteness. This is clearly demonstrated when we have some unusual condition which makes an object that is relatively near appear vague or dim in outline. For example, one is very likely to judge wrongly the distance of a car when it is seen on a foggy night. One who has encountered a car suddenly looming out of the fog realizes the nature of this error. The artist uses this

principle to suggest perspective in his picture by making dull in outline the objects that he wishes to appear distant.

2. *Superposition.* In the complex arrangement of objects which fill our environment, it is inevitable that some should be hidden behind others. Consequently, when we see only a part of an object because another object covers the rest of it, we learn to suppose that the covering object is the nearer. If we had no way of verifying the fact of superposition, we could get some very striking illusions. The shadow performances that are commonly given on Hallowe'en are based on this principle. By arranging the shadows one can give the impression of performing an operation, cutting off a limb, removing the internal organs of the victim, and the like, because there is confusion in the perception of the witness. All the objects are thrown on a single screen and the witness, reading superposition into them, gets the illusion.

3. *Shadows and shading.* We see an object because of the lights which are reflected from the various surfaces of the object. The lights from various parts depend upon the source of light with reference to the observer. From this fact we learn that a shadow indicates solidity of such a nature that the source of light is kept from illuminating all surfaces as strongly as the surface turned directly toward the light. After this is learned, a shadow becomes related perceptually with solidity and to have solidity suggested all we need is to have shadows. This is probably one of the most important of monocular factors and is used very effectively in all pictures. To be sure, this factor is seldom realistic enough to deceive us and we can tell a picture from a relief, but it does give us enough suggestion to enable us to tell that the artist meant the object to have solidity.

4. *Size of familiar objects.* The size of the visual image has much to do with our perception of size. The size of the image depends upon the relation of the size of the object to the distance it is from the eye. If the image is to remain the

same, the size of the object must increase as it is removed from the eye. An object of constant size produces a larger and larger image as it comes closer, because a larger area of the retina is involved. If we are familiar with the size of an object, we can judge the distance it is from the eye by the size of the visual image. If we do not know its size, we make gross errors in judging its distance. As we become more and more familiar with our surroundings, we learn the sizes of objects more thoroughly and become better able to use the factor of relative size in judging spatial relations.

5. *Shape of familiar objects.* Any one who tries to draw knows that the shapes he uses in his pictures of objects are not the same as the shapes of the objects themselves. It is the relationship between the shapes as made on the plane surface and the shapes as we know them to be by experience that gives us one of the ways in which to judge distance or depth. When we represent the wheel of a wagon as an ellipse, we know that the wheel is round, but its representation as an ellipse tells us that instead of looking at it squarely we are looking at it when one side is farther away from us than the other.

6. *Relative motion.* When we change our position in relation to our environment certain alterations appear in our perceptions of space: (1) the apparent sizes of the objects may change, (2) their superposition may be altered, and (3) their relative clearness may change their shading as well as the shape of the visual image that they cast upon the retina. Motion, then, is one of the most important factors in the perception of spatial relations of any sort; it furnishes a sort of experimental check upon the data obtained in other ways. If one did not move, he would forever be without any notion of space. He would never learn that he could not reach the moon or that an orange has solidity, and the thousand and one spatial factors which we all take so much for granted would be unknown to him.

Binocular Factors. It is very easy to demonstrate that our perception of distance is much more accurate when both eyes are used than when one eye is used.

With one eye closed approach some object directly and with a sweeping movement of the arm from one side try to bring the finger to a point on this object. It will be found that the error is greater under these conditions than when both eyes are open, especially if the object has little depth. The two main factors responsible for this increased accuracy resulting when both eyes are used are the convergence and divergence of the two eyes, and the fusion of the retinal images of the two eyes.

1. *Convergence.* When the object observed is at a great distance, the angle subtended by the axis of the two eyes (the axis from the fovea through the lens) is very small. As the object approaches, the eyes converge so that the angle becomes larger and larger. Just how important this factor is in the perception of depth is hard to determine since it cannot easily be isolated from other factors, but it is fairly certain that it plays some part.

2. *Fusion of retinal images.* Furthermore, if the two eyes are fixated on one object and a second object lies nearer to the eye than the one fixated or farther away than the one fixated, the second object will appear double. This is because the second object stimulates the retina either on the temporal side of each fovea or on the nasal side of each fovea. Ordinarily images seen on the temporal side of each retina or on the nasal side of each retina do not come from the same object. They do not fuse, and so they give rise to a perception of two objects. If, however, they fall on the nasal side of one retina and on a corresponding part of the temporal side of the other retina, they do fuse. This fusion or lack of fusion is important in the perception of depth. Because of this stimulation of non-corresponding points, an object with some depth or solidity makes a

different image on each eye, and we come to interpret these disparate images as evidences of distance, depth, or solidity.

This can be illustrated, as in Figure 37, by comparing the images made in the two eyes when a book is held before them. Hold the book in the median plane of the body, about eighteen inches from the eyes, with the back toward you. If you close your left eye, you will see the back of the book and a part of the front cover. The back cover will be totally invisible. Now close the right eye, and you will see the back of the book and a part of the back cover. Look with both eyes and you will see the book as a solid object because you see one part of it with one eye and another part with the other eye.

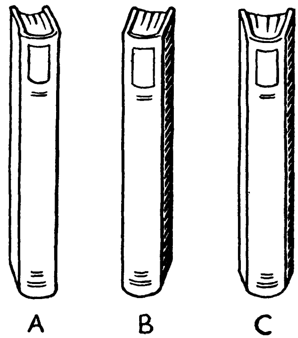

FIG. 37. ILLUSTRATING PERCEPTION OF DEPTH BY BINOCULAR VISION

A, view of book as seen with the left eye only; B, as seen with the right eye only; C, as seen with both eyes.

The stereoscope provides a practical application of this principle. Two pictures are taken by lenses spaced the same distance apart as the two eyes. The two pictures resulting are different, and represent the scene as imaged by the right and the left eyes. These two pictures are mounted on a card side by side. When viewed through the stereoscope, one picture is seen with each eye. The fusion of the two gives the observer the same perception of depth as he would have if he looked at the original scene with both his eyes. This principle is now being used in moving pictures to give depth to the picture.

Binocular Rivalry. If the two retinas are stimulated by fields which are so incongruous that they cannot fuse in the manner just described, they are not seen as a single object, and in place of fusion there is a rivalry between the two retinas.

The effect of this rivalry is that first one retinal field predominates and then the other, recurrently. A simple way to demonstrate this rivalry is to cover one eye with the hand and then face toward the bright sky. The dark and light fields will be seen alternately. This phenomenon can also be demonstrated by means of the stereoscope. The horizontal and vertical lines in Figure 38, when seen through the stereoscope, will alternately appear solid.

If the person of normal vision looks at a large white surface through glasses having one red and one green lens, there will

FIG. 38. STEREOSCOPIC DRAWING FOR ILLUSTRATING BINOCULAR RIVALRY

be a rivalry between the two eyes and the subject will report an alternation between red and green. That this rivalry is the result of experience has been demonstrated by the testimony of a person who, blind at birth, later recovered her vision. When she looked through a pair of such glasses, she reported as follows: " I see a large sheet of red cardboard with my right eye and a sheet of green cardboard with my left eye. They are both in the same place, and I am just as sure that I see them both at the same time as I am that I am standing here." Her experiences had not been of such a nature that she was forced either to see a fusion of images or to experience a rivalry between them. She could see two disparate images at the same time. Thus, perception of spatial relations by the coöperation of the two eyes is based upon the individual's experience.

XXVIII. Illusions

We have shown that in our original reactions to our environment we make gross errors and that the development of perception takes the form of a continual correction of these reactions to conform more nearly to actual spatial data. With all this readjustment or learning there is a residuum which we seem unable to correct, and this leads to the phenomena of persistent illusions. A consideration of them should convince us that we cannot place implicit faith in our perceptual interpretation of our environment.

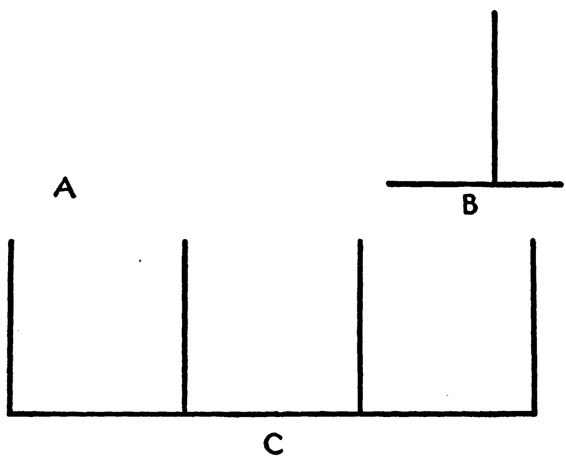

Fig. 39. Vertical-Horizontal Illusions

In A the upper dot is the same distance from the left one as the right one is. In B the horizontal line is the same length as the vertical one. In C the vertical lines are the same length as the horizontal distances between them.

When perception fails to give us the true character of the experience perceived, we have the phenomenon of illusion. Illusions may arise from inadequate or incorrectly interpreted experience in any of the sense organs — thus, we may have auditory, olfactory, and tactual illusions — but the most common illusions are those related to visual perception.

Visual Illusions. Some common visual illusions are as follows:

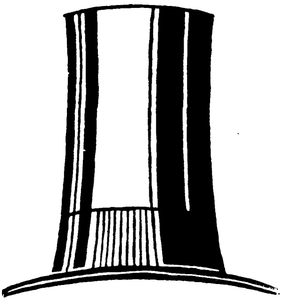

Fig. 40. The Vertical-Horizontal Illusion Has a Practical Bearing

The hat is just as high as the brim is wide. (From Robinson and Robinson, *Readings in General Psychology*. 1923. Used by permission of the University of Chicago Press.)

1. *Vertical distances are perceived as greater than mathematically equal horizontal distances.* If we erect a perpendicular upon a horizontal line of equal length, the vertical line will appear longer. (See Figure 39.) A pole or tree is generally thought to be taller when standing than when lying on the ground. The height of the hat in Figure 40 appears to be greater than the breadth of the brim and yet they are proved equal by measurement. This principle has important applications in architectural design, in the design of advertisements, and in landscaping.

2. *Filled or divided space appears greater than empty or undivided space.* Various forms of this illusion are illustrated in Figure 41. A space filled with transverse lines appears greater than a corresponding empty space. A space filled with heavy shadows appears greater than an equal open space. The illusion is strikingly seen in the three square areas.

A practical application of the principle involved in this illusion is illustrated in Figure 42. The borders of trees along the drive make the driveway appear to be longer than it would were they absent.

3. *Contours of various sorts lead to defective perceptual in-*

terpretations. Various forms of this principle are seen in Figure 43. Two equal semicircles appear different when one of them is closed by a straight line. The broken circles give one the impression that the arcs were not drawn from the same center. The three incomplete squares depend partly upon

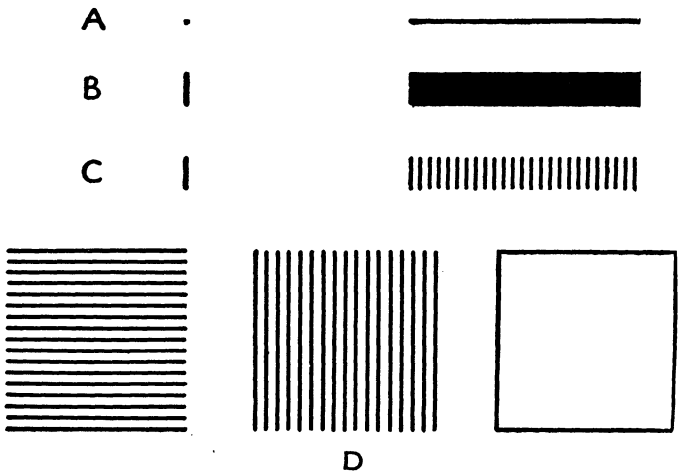

FIG. 41. ILLUSIONS OF FILLED AND EMPTY SPACE

The filled and empty spaces in A, B, and C are equal, but the filled space appears greater whether it is a straight line (A), a shaded area (B), or contains transverse lines (C). The three areas in D are the same, yet the one filled with horizontal lines appears higher than its width, and the one filled with vertical lines appears wider than its height.

the vertical-horizontal illusory effect, partly upon the filled-and-empty-space illusory effect, and partly upon contrast. Most contour illusions involve more than one illusory principle.

4. *Contrasts accentuate differences.* This illusion is apparent in many fields. Sugar tastes sweeter if taken after vinegar. Silence is more striking after we have been in a din. A short

man looks shorter when accompanied by a very tall person. A fat man looks fatter when in the company of an extremely lean person.

A simple illustration of contrast is found in Figure 44. The small portions in the center of each line are equal, but the portion between the long arms looks much smaller than the small portion between the short arms.

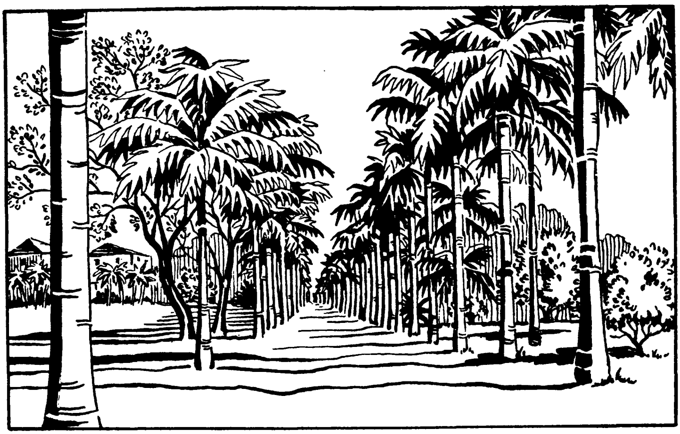

FIG. 42. ILLUSTRATION OF PERSPECTIVE

Cover up the rows of trees and note how much shorter the road appears.

5. *Illusions may be produced by context.* In the Müller-Lyer illusion, illustrated in Figure 45, the judgment of the length of lines, or the estimation of distance, is affected by the position of adjoining lines. The distance between the arrowheads is the same in each set of lines, but the illusion persists even when we know that the lines are the same. At B in the figure is a modified form of the Müller-Lyer illusion. The distance between the vertical lines is the same, but the space appears smaller when the wings added to the verticals turn toward the

intervening space, and larger when they extend away from the intervening space.

Another illustration of the effect of context is shown in Figure 46. Here the fish may appear to be small or large depending upon whether it is seen in connection with a large hand or a tiny man.

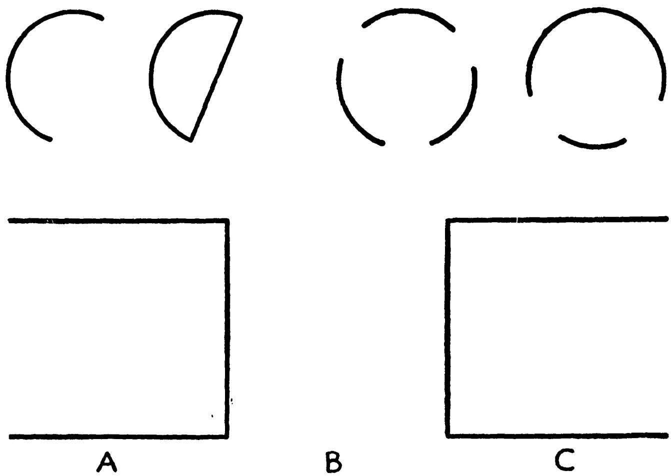

FIG. 43. CONTOUR ILLUSIONS

Closed or connected arcs appear different from open arcs. The three incomplete squares A, B, and C, are equal, but the absence of various sides of the squares distorts our judgment of their size.

6. *The apparent direction of a line is influenced by the presence of other lines.* In general acute angles tend to be overestimated and obtuse angles tend to be underestimated. A striking illustration of this is shown in Figure 47. The horizontal lines appear to be curves, but the application of a ruler will show that they are straight. Other examples of this illusion are given in Figure 48.

Proof Readers' Illusions. The fact that it is extremly dificult to read printed materiel and to detact all the errers in speling and punctuation is notorios. Even the most skiled proof-reeders are very apt to overlook an errer which is perfecly obvius when atention is caled to it. There are fourteen

FIG. 44. EFFECT OF CONTRAST

The small portions in the center of each line are equal.

errors in the preceding two sentences. How many did you notice as you read them?

The nature of the reading process and a consideration of the manner in which we learn to read furnish an explanation for these failures to detect misprints. When we first become acquainted with a language, we spell out words. As we become more accustomed to words, we see them as units, so that adult

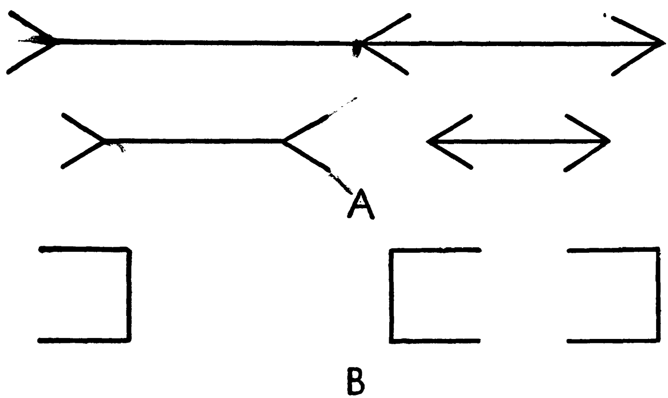

FIG. 45. TWO FORMS OF THE MÜLLER-LYER ILLUSION

reading is based on the perception of a group of letters. The purpose in looking at this grouping of letters is to ascertain the meaning of the printed symbols. These two factors, the perception of a group of letters as a unit and the purpose behind

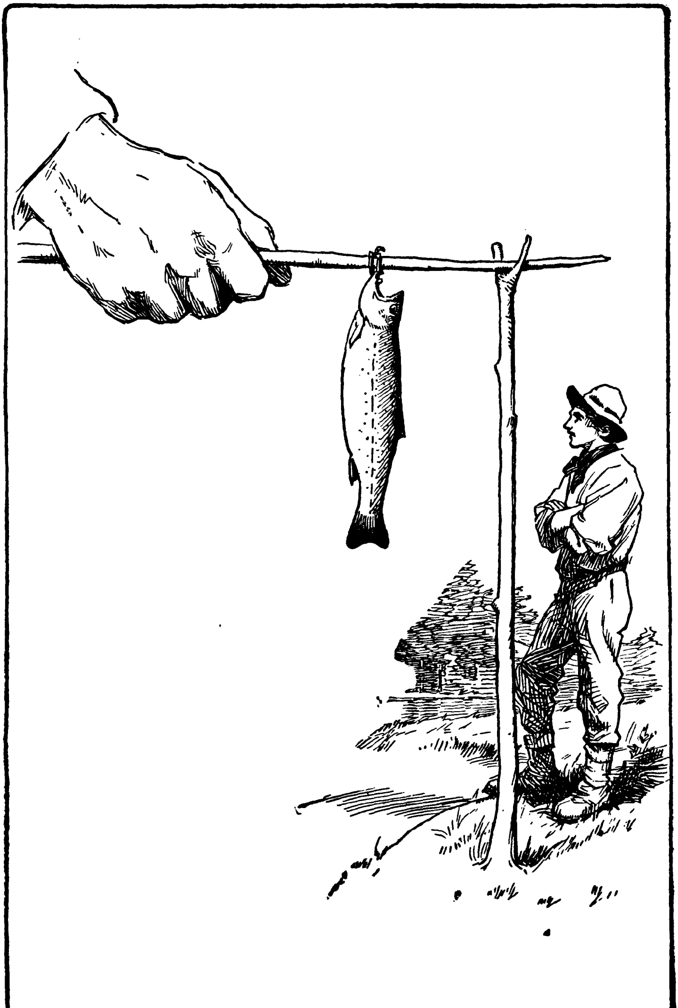

FIG. 46. THE INFLUENCE OF CONTEXT
(From Bennett, *Psychology and Self-Development*. Ginn and Co.)

the perception, explain the ease with which we may overlook a mistake in printing. When we read we see words and not letters. This can be demonstrated very easily. If we should omit the spaces between words so that we would have only a series of letters, itwouldbeverydifficulttoread. Didyoufinditso?

Explanation of Illusions. Various attempts have been made to explain illusions. In each specific case various factors obtain, but in general it may be said that an illusion violates what we have been taught by the preponderance of our experi-

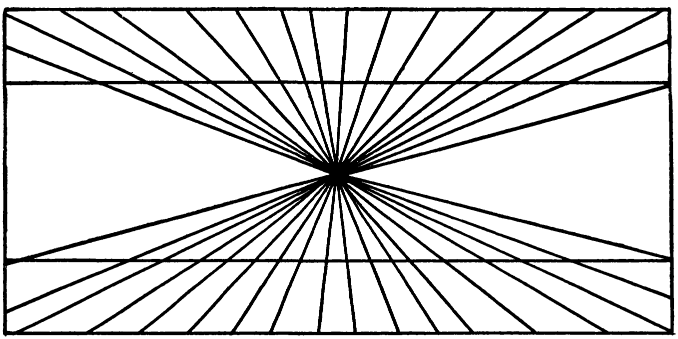

FIG. 47. ILLUSION PRODUCED BY THE INFLUENCE OF ANGLES

ence. By reacting as we usually do, we are led to expect a certain condition to obtain. When we can arrange materials in the objective world so that they violate such expectation, we have a persistent illusion. This factor of expectation is well illustrated in the size-weight illusion. If two blocks of wood of different size are weighted so that the smaller one weighs exactly the same as the larger one, the smaller one will seem to be much heavier than the larger one. If, however, we make a piece of lead equal in weight to a piece of wood, although the disparity in size still exists, the illusion will tend to disappear. It is quite likely that in the case of the two blocks of wood, after we have lifted the larger piece of wood, we expect the smaller block to be much lighter and adjust the force with which we lift it accordingly. It fails to rise as quickly as it should with this force applied, and consequently we judge it heavier. Such expectation is purely the result of previous experience and is not due to any rational process. This is evidenced by the fact that the illusion persists even after we know that the two blocks weigh the same.

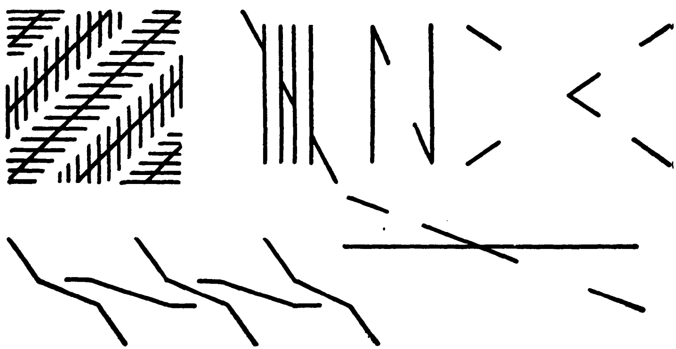

FIG. 48. ANGULAR ILLUSIONS

XXIX. VARIOUS FORMS OF PERCEPTUAL INTERPRETATION

Of special interest are the perceptual factors involved in the judgment of time, in reading, and in the localization of sounds. The consideration of these indicates the improvement that may be achieved in some fields, as well as the limitations which obtain in others. The failure to recognize that in all perceptions there is an individual element may lead to unwarranted confidence in our own interpretations. When a perception persists as real despite the fact that it is in direct violation of sensory data, the individual has what is known as a hallucination.

Perception of Time. Neither human beings nor lower animals have any mechanism whereby they can accurately perceive temporal relations. Chickens have been known to go to roost during an eclipse. Their experience has taught them that darkness spells night, rather than a certain interval of time since sunrise. Quite likely a human being without mechanical devices to guide him would likewise be very inaccurate in his perception of time relations. To overcome this handicap, man has devised time-measuring instruments. He arranges clocks so that they strike the hour. He has whistles, gongs, and other devices to remind him of the hour. Surely all these inventions bear witness to the fact that man needs these things to help him perceive time.

On the other hand, there are persons who report that they are able to retire with the thought that they will arise at a certain time and are able, without sleeping any less soundly, to awaken at the time specified. If such persons were accurately checked, it is quite likely that their judgment would not be so accurate as they think. It is also likely that certain conditions, such as customary light and sounds, help them in arising at the time specified. Nevertheless, certain physiological rhythms and changes in the metabolism of the body may give one some notion of time sequences. Hunger, for example, may warn us that it is nearly the hour to dine. If, however, we had nothing but such stimuli to guide us, we should often fail to realize that it is mealtime, especially if we were particularly interested in some task. We all consider it safer to carry a watch or to have a clock within consulting distance.

The ear is better able to distinguish small intervals of time than is any other sense organ. If one stimulus is followed closely by another, the ear can distinguish them as two if they are separated by an interval as small as 10 sigma (sigma equals one one-thousandth of a second). If the stimuli are given by touch, we can distinguish them as two if they are 25 sigma apart. If they are given by vision, they must be separated by an interval of between 50 and 100 sigma. These comparisons indicate that the ear is primarily the organ of time perceptions. Music, largely dependent upon sequences of sounds, is very pleasing to the auditor. A corresponding sequence of lights would be very annoying, as facing a flickering light demonstrates clearly.

Our estimation of longer periods of time is influenced by the events that occur in the intervals to be estimated. If the interval is filled with events of an interesting nature, the time seems short. If the interval is unoccupied or the events are uninteresting, the time seems long. On the other hand, if we estimate time in retrospect, the situation is reversed. If we recall a period in which many exciting things happened, that period seems long; a similar period in which nothing happened will seem brief in retrospect. Obviously, time which is filled with activities is much to be preferred to idle time. The occupied time seems to pass more quickly and in retrospect is much more satisfactory than time which has been idled away.

Perception in Reading. Photographic studies of the movements of the eyes in reading have demonstrated that the eyes do not move smoothly over the printed line but jump from one fixation point to another. This means that with each fixation point the eye must see a group of syllables or words as a unit, and then pass over the intervening space and see the next group as a unit. For lines ranging from 85 to 100 mm. in length, the ordinary reader makes from about three to six stops, and the time he stops at each fixation point ranges from 160 to 400 sigma. He perceives one or two ordinary words at each pause.

This photographic technique has been used with success in diagnosing cases of poor readers. It has been found that some persons tend to jump too far and, as a consequence, they have to jump back and reread the material. Some jump too short a distance and thus have too many stops per line. It was found in the case of a boy who was a particularly poor reader that, instead of jumping from one line back to the beginning of the next, he would traverse each line from right to left before starting to read it. When this was discovered, the boy explained that he always looked over the line to see whether there were any words he did not know. Certainly going backward over the line is not the most favorable way to learn the meanings of words or phrases.

The facts discovered in these investigations have revolutionized the teaching of reading. Instead of emphasizing the letters in a word, the teacher now presents the word as a whole. The child often recognizes the word and knows its meaning before he knows how to spell it. This method may make poor spellers, but it makes good readers, and after all most of us are more interested in reading than spelling.

Improvement in reading can take various forms: (1) one can train himself to perceive more material with each fixation, and thus make fewer stops per line; (2) he can increase the accuracy with which he makes his fixation pauses; and (3) he can emphasize the extraction of meaning from the material rather than the mere mechanical process of going over the printed symbols. The printed symbols are designed to convey meanings, but unless one is on his guard against it, he may get into the habit of seeing the symbols merely as so many printed characters without giving due regard to the meaning behind them.

Auditory Localization. Anyone who has tried to find a knock or squeak in his automobile will bear witness to the difficulty of localizing a sound either with respect to the direction from which it comes or its distance from the observer. Experiments in the laboratory demonstrate that we are inherently unable to localize sounds accurately. In attempting to isolate the factors upon which localization of sound depends, there has been disagreement but it may be worth while to survey these findings.

Our judgment of the distance of sounds is based upon their intensity and upon their tonal complexity. The intensity, of course, increases as the source approaches us; but this factor alone would give us a very poor estimate, for very weak sounds can be produced in close proximity to our ears. The sound that is near, in addition to being more intense, is likely to be more complex. Vibrating bodies emit a series of overtones of varying strength. As the vibrating body recedes, these overtones are the first to disappear and finally only the fundamental tone is audible. For example, the whistle of a locomotive, heard at a distance, is hollow and flat, but, when heard near at hand, it is shrill, harsh, and piercing because the partials and overtones which have become audible add to its complexity. A practical application of these facts is found in ventriloquism. The ventriloquist simulates the sort of tone one would hear were the source of the sound at a distance, and the hearer gets the characteristic illusion.

Judgment of the direction from which a sound comes is still more difficult. The body of evidence at hand indicates that what sense of direction we do have is based upon the difference between the stimulation of the two ears. One group of experiments seems to indicate that this difference is one of intensity; another group seems to indicate that it is a difference in phase. Confirmation of the latter group is found in the fact that when a sound is produced in the median plane, it cannot be localized at all. When the sound is not in the median plane, judgment is more accurate but still very faulty.

Hallucinations. Throughout our study of perception we have seen how the experience of the individual determines his interpretation of the objective data which he receives through his sense organs; but in all the instances we have studied, the objective data played an important part in such perceptual interpretation. In some instances the objective data greatly overrule the individual elements in interpretation; in others the individual elements predominate. We come now to consider instances where the perceptual material is almost wholly the product of the individual's reaction and depends very little, or not at all, on the sensory data. When the perception is of this order, it is called a *hallucination*.

If a man says that he hears a voice calling him names and everyone else in the vicinity fails to hear any such voice, it is evident that the man is having an individual experience. To the outsider this is nonsense, but to the one having such a hallucinatory experience it is just as real as though a person actually spoke to him. He hears the voice although he cannot see the speaker.

The effects of such an experience may be of different sorts. The person may continue to insist that someone spoke to him, in spite of the evidence that no one was around. He may insist that he has special powers, that the voice was carried to him by mysterious forces, that everyone else is lacking in a peculiar gift which he possesses, or he may advance some other explanation. In other instances the person experiencing a hallucination may admit that it is probably an individual experience, and accept the evidence from others that no one is around. This latter type of reaction is the rational way to treat such an experience.

Few of us are likely to encounter a marked case of hallucination either in ourselves or in another, but the fact that this situation may exist demonstrates a principle that should be recognized in our study of perceptions. The rational man admits that his perceptions may be in error. He is willing to check up the interpretations of one sense by evidence from another. If he experiences contradictory auditory and visual perceptions, he knows that one or the other must be in error, and he checks them with other facts to determine which one is correct. He may do this by measuring, verifying, using other sensory data, or asking others what they have observed. If he perceives one thing and all, or even a few, of those around him contend that they perceive something different, he is willing to admit that they may be right and that he may be wrong.

Usually the man who contends that his hallucinatory experiences are the correct ones and who insists that, despite all external evidence, all other persons are wrong is considered mentally unbalanced. The judgment that he is unbalanced does not arise from the fact that his experiences have led him to a unique interpretation, but from the fact that he foolishly believes that he alone is right, or that objective facts are wrong if they conflict with his individual perceptions. Perceptions grow through reacting to our environment, and where one reacts, he is sure to make some errors. The recognition of these errors is part of the learning process. The wise man admits that he may be in error even in such a basic psychological experience as the immediate interpretation of sensory data; that is, in his perceptions.

The great lesson, then, to learn from a study of perception is that we interpret things in terms of our own experience and since our experience may be unique, or at least somewhat different from that of others, it is not fitting for any one person to insist that what he has perceived must be correct; he needs to be tolerant of the perceptual interpretations of his fellows.

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CHAPTER VII

LEARNING

XXX. The Nature of Learning

In a broad sense learning may be regarded as the modifications which result from experience. These may be very simple or extremely complex, the most complex being found only in man. These modifications serve the function of enabling the organism to adjust to its surroundings. To adapt well is to learn well.

Universality of Learning. Anyone who has had experience in driving a nail knows only too well that, if the nail bends, it is generally better to pull it out and drive another. In the process of bending and straightening, the iron in the nail is annealed, thereby making the nail more difficult to drive. We may say that the nail has learned or formed the habit of bending.

Most of us have, in looking over our last year's wardrobe, decided that some old suit of clothes is good enough for some more wear. But after we have had the suit cleaned and pressed, we have generally been disappointed to find that it will not hold its shape. When it first came back from the cleaner's, the creases stood out and the old wrinkles were all gone. But in a short time the old wrinkles were back. The clothes had " broken " and it was impossible to make them hold their shape.

A shrub that has been bent by the wind or snow never stands quite so straight as before, and it is always more easily bent again. A dog finds a hole under the fence in the yard, crawls through the hole, and forms the habit of getting out of the yard by crawling under the fence. A boy forms the habit of brushing his teeth each morning before breakfast.

These are all examples of learning.

Characteristics of Learning. What then is learning? We find certain tendencies in nature like the bending of the nail. This tendency depends upon a certain plasticity or modifiability of the structure of the material — the capacity to show permanent effects of certain forces acting upon it. This modification is retained and forms the basis of a new type of reaction. This illustrates the essential nature of learning. In its broadest sense it includes modifications in the inanimate as well as the animate kingdom. The difference is one of degree rather than one of kind. But since there is so much greater modifiability in animals and since we are particularly concerned with animals, we shall restrict the use of the term to this narrower field.

Human Learning Centered in the Synapse. The possibilities of modifiability are largely in the nervous system. There may be some modification in the muscles as a result of learning, but the greater part takes place in the nervous system. Various theories have been proposed to account for the changes that occur in habit formation. The most generally accepted theory is that a change takes place in the synapse. It is assumed that there is a resistance to the passage of a nervous current at each synapse. In responses of the unlearned type the resistance is relatively lower than it is in other pathways. As a result of practice, however, other synaptic resistances may be lowered, so that they too become regular pathways. The lowering of synaptic resistances is possible because of the modifiability and retentivity of the nervous system. Modifiability and retentivity are the two significant characteristics of the nervous system which form the basis for all learning and habit formation.

Comparison of Learning with Innate Behavior. Learning differs from an innate response in that an innate response is ready to function without previous experience, while in learning, the neural pathway must be made more pervious as a result of practice. Let us now consider how learning takes place.

In Chapter V we considered the native basis of behavior. All animals are born with certain innate capacities for response. In the lowest forms of animal life these innate capacities are about the only ones the animal has. By this we mean that the animal never learns many new forms of behavior beyond those with which it is born. For example, the amœba has certain forms of behavior, which we call tropisms, that impel it to go toward certain things and away from others. The amœba will seek neutral temperatures and places where the light is not too strong. It will approach, when in need of food, certain substances. If these substances are noxious it will withdraw from them. But it would be a long, long task, if not an impossible one, to teach the amœba to avoid a certain kind of substance without first approaching it each time. In contrast with the amœba a chick will soon learn to avoid certain kinds of caterpillars which are not edible. After a few unfortunate experiences with such caterpillars, the chick will go about its feeding, never pecking at the disagreeable worms. The chick has *learned* to reject certain substances as food. It also learns the desirability of certain other substances as foods.

The innate traits may be relatively simple, as in the amœba, or they may be complex. As an example of a complex native trait let us consider the behavior of a bee. Wonderful stories are told of the organization of a hive of bees. Each worker has certain tasks to perform. Some are water carriers, others are gatherers of honey or wax, some act as servants for the queen, and others as a bodyguard for the hive. If we follow any bee during its activities, we will find that its behavior is very complex. It responds to certain kinds of stimuli positively, to other types negatively, and to some types not at all. For example, in gathering honey a bee will go to flowers which are rich in nectar, it will avoid certain poisonous flowers, and other plants it will ignore. Likewise, the bees that build the comb react to the substance to which the comb is to be attached by making the comb conform to the size and shape of the cavity to be filled. Reactions of this kind may be considered adaptations. Yet the bee to-day, so far as our evidence goes, builds its comb just as bees did in the time of the Pharaohs. Furthermore, young bees seemingly build just about as good combs as old bees; that is, the young bees do not have to learn how to build a comb.

Besides adapting itself to the place where the comb is to be built, the bee must also adapt itself to the water and food supply of the vicinity. It seems quite reasonable to consider these adaptations as learning. If they are so considered, *learning may be defined as some modification in the behavior of an organism as a result of experience which is retained for at least a certain period of time by the organism.*

It is this degree of adaptability which differentiates the higher from the lower organisms. If the environment of one of the lower organisms is greatly changed, the organism is unable to meet the change and will die. In the higher organisms, if such a change occurs, the animal will either move to another situation or change the conditions. For example, if the temperature conditions of an amœba change too rapidly or too frequently, the amœba will die. In a similar situation a man will build a shelter, put out the fire, or move to another climate. Man's versatility is his salvation.

It should be clear at the beginning of a study of learning that inherited or innate behavior forms the basis for all learning. This innate behavior may be tropistic, reflexive, instinctive, or random. The process by which these types of innate behavior are modified is essentially the same in any case. The greatest difference is in the degree of difficulty of modification, which is roughly in inverse order to the way in which we have listed them.

XXXI. Kinds of Learning

There are five ways in which original nature is modified. They are: (1) substitute stimulus, (2) substitute response, (3) negative adaptation, (4) combination, and (5) fixation of random movements. We shall consider each in turn, remembering that they are only adaptations of the principle of the conditioned response, as described in Chapter II.

Substitute Stimulus. In this type of learning one stimulus is substituted for another. In terms of the nervous system this means that we have originally two stimuli, one adequate to produce a certain response and the other inadequate. When both stimuli are presented simultaneously, the two aroused nervous currents tend to drain into one common pathway. In this case it is the pathway leading to the response innately connected with the adequate stimulus. The effect of repeated simultaneous stimulation is to lower the resistance between the inadequate stimulus and the response called forth by the adequate stimulus so that later the second, as well as the first, stimulus will produce the same response. The effect of such training is illustrated in Figure 49. Pavlow's experiment in teaching the dog to respond to the ringing of a bell by an increase in the flow of saliva is a good example of learning by substitute stimulus.

But we do not have to limit ourselves to such seemingly artificial examples as this to illustrate the principle of substitute stimulus. Learning to talk is a matter of substituting certain sounds for the object. When the cat comes into the room with the small child, the mother begins to say "kitty, kitty." When the cat has gone out of the room, the mother can say "kitty, kitty" and produce the same response in the child as the cat did. The spoken word has been substituted for the animal itself. Furthermore, the child soon learns to produce the sounds himself and to use these sounds as substitutes for the object. A large part of his second and third years are taken up with the problems of substituting spoken symbols for objects, and in learning to use these symbols in talking and thinking.

When the child goes to school, he is confronted with the further problem of learning to substitute certain printed symbols

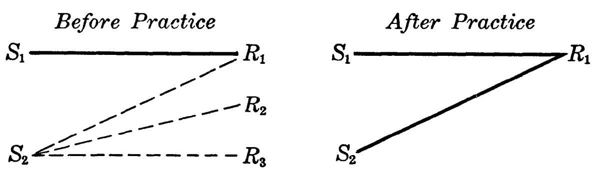

FIG. 49. THE MECHANISM OF SUBSTITUTE STIMULUS

S_1 naturally elicits R_1. S_2 has no specific response. After practice, during which S_1 and S_2 have occurred together, S_2 becomes an adequate stimulus to elicit R_1.

for his spoken words. The teacher prints the word *kitty* on the blackboard or shows it to him in a book and tells him that this is kitty. He must learn these visual symbols as substitutes for his vocal symbols.

Later when he studies a foreign language, he must learn other spoken and printed symbols as substitutes for his English words.

The principle of the substitute stimulus has many practical applications. The public speaker and the salesman soon learn to use substitute stimuli. Direct methods often do not work. The better life-insurance salesmen do not talk much about accidents and death when selling insurance. Accidents and death have come to have too many repellent associations to lead to the positive results the salesman wants.

Slogans, trade names, and patented signatures are devices for indirectly suggesting responses. They are substitute stimuli, standing for the real article. In some cases a word comes to stand for a whole class of articles. The word *kodak* not only stands for the small cameras made by the Eastman Kodak Company but also for all small cameras.

Substitute Response. Another way in which original reactions are modified is by substitute response. In many cases it happens that the closest attachment between stimulus and response does not produce the most desirable response. Other responses may be made which are found to be more satisfactory. These responses are then connected with the stimulus as a substitute response.

In boxing, for example, the normal thing to do when some object, such as a fist, is seen rapidly approaching the face is to shut the eyes and dodge. But a boxer soon discovers that this is not a very effective type of response. He is not able to dodge quickly enough to avoid the blow. He is likely to find by experience or training that it is more efficient to put the hands up for a defense, block the blow with the hand, keep the eyes open, and return the blow. Here we see that keeping the eyes open is substituted for closing the eyes, and a guard position for the hand is substituted or added to the dodging. Correct positions and reactions in athletics and all skilled activities are generally substitute responses. The principle of the substitute response is illustrated in Figure 50.

The small child learns to substitute other responses for crying. Adults have all sorts of substitute responses in social situations. In court we swear the witness in an attempt to prevent his giving substitute responses to the questions asked.

Negative Adaptation. The elimination of unsuccessful, wrong, or fruitless activity is as much a part of learning as the formation of successful responses. Such elimination is also a form of substitute response.

In learning of the type we have been describing heretofore, a certain stimulus is accompanied or immediately followed by a specific situation. In learning the learner discovers a response which satisfies this situation. If, instead of a stimulus being accompanied by a specific situation, it is accompanied or followed first by one situation and then by another, no single response can be adopted. For example, when a man begins to work in a noisy factory, the noise is a stimulus to activity. Since, however, there is first one and then another sequence to

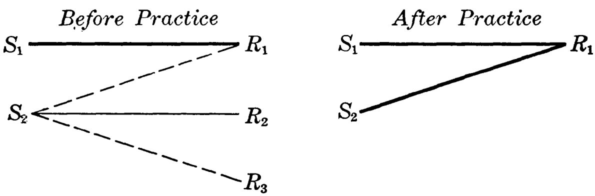

FIG. 50. THE MECHANISM OF SUBSTITUTE RESPONSE

S_2, which is strongly connected with R_2, becomes connected with R_1 instead because of its association with S_1–R_1.

the noise, no specific response will be formed. At first general nervousness may result. Later the worker may become *negatively adapted* to the noise.

In much of our learning there are many stimuli which first attract the attention of the learner. Since these have no significance, he tends to disregard them. The automobile mechanic learns to listen for certain significant sounds in a car while it is in motion. All other noises are neglected. The doctor learns to look for certain significant signs of diseases. All the hundred and one normal bodily functions he must learn to neglect when he is looking for disease.

Another type of negative adaptation occurs when there is a specific situation present in connection with a stimulus. If the response selected fails to give satisfaction, no response at all may be found more satisfactory. A spider's web was touched by a vibrating tuning fork. The spider immediately ran to cover. The experiment was repeated over and over again. Finally, since no harm came to the spider, it became negatively adapted to the tuning fork and paid no attention to it.

In a third type of negative adaptation there is an innate connection between stimulus and response. If, however, the response brings annoyance rather than satisfaction, the response will tend to be eliminated. If some other response is discovered, it will be substituted; if not, the stimulus will gradually fail to elicit any response. A bright light has great interest for the child. If upon reaching for the light the child is burned, it will not take many repetitions for him to become negatively adapted to reaching for bright lights.

Combination. Another form of modification of responses, or type of learning, is by combination of responses. Complex acts are made up of simple acts. This combination may be a parallel combination or a serial combination, but more commonly it is both. The parts which are combined may be either innate responses or responses learned by any of the methods already described.

All skilled acts are the result of combination. No complex movement is taken bodily from any previous act; it is always a mosaic with its parts taken from any and generally from various sources. The problem of combination is not only one of the selection of the parts which are to be combined into the larger movement, but also of how they are to be combined. The serial arrangement of the parts is very significant. It is just as important that any part of the act be performed at the right time and with the proper emphasis as that it be performed at all. A step in a dance must come at the right place and with the correct tempo. The serial order in starting a car is generally important. In laying a brick in a wall there are many steps that must be performed and, for the most part, these must be in a certain order. It is just as serious an error to do the right thing at the wrong time as it is to do the wrong thing at the right time. In fact the statement just made is paradoxical, for what otherwise is " right " or " wrong " fails to be right or wrong when it is out of proper order.

In learning to skate certain movements of walking are combined with other body postures plus certain instinctive reactions against falling. Playing a pipe organ is another good example of combination. One who has never played a pipe organ can only marvel at the intricate movements which are made in playing. Often one hand is playing on one manual of keys while the other is playing another manual, and all the time the feet are playing the bass notes. At intervals one hand or the other must quickly manipulate the stops. This must all be done at a certain tempo and rhythm, as well as with the right touch to the keys.

Fixation of Random Movements. Yet another method by which new responses are acquired is through the fixation of random movements. A random movement is one which is made, not as a specific response to a definite stimulus, but rather as a response to general stimulation. Processes of digestion, the pressure of the air, and other external and internal stimulation produce nervous currents for which there are no specific outlets. They flow out over one or another motor pathway in more or less chance order, depending upon whichever factors that may change the direction from one pathway to another happen to be operating.

The baby, when awake, is almost always moving about. His legs and arms are in motion almost constantly. Some bright object may be presented to him. This produces a stimulation, but he has no ready-made type of response. Instead of making the specific response of reaching, the baby kicks, squirms, and frantically waves his hands. These movements are not direct responses, or at least they do not appear as such to the observer. They are what psychologists choose to call random movements.

Some of such random movements produce a result which is agreeable to the baby. When the bright object is held before him, he may accidentally touch it. This gives him pleasure. The next time it is held before him, random movements again occur. But the results of the earlier success, by a method to be described later, tend to make the pathway which produced the earlier success more permeable. Therefore there is a greater tendency for the nervous current to pass over this pathway than over the others. This difference in resistance is not great for the first few trials, but as more and more responses are made, the course along the given pathway tends to become more deeply seated. The result is a learned type of response. In this manner many random responses become fixed into useful acts.

XXXII. The Laws of Learning

We have thus far accounted for the ways in which new types of reactions are acquired. The problem still remains to show how these new forms of behavior are fixated into routine acts. A few simple laws which account for this fixation process are: the laws of (1) use, (2) disuse, (3) effect, (4) primacy, (5) recency, and (6) vividness. The first three are called primary laws and the last three secondary laws.

Primary Laws of Learning. The first three laws of learning — use, disuse, and effect — are known as the primary laws.

1. *The law of use.* The law of use may be stated as follows: Of two neural pathways, other things being equal, the one which has functioned most often will be most ready to function again. In other words, practice facilitates response. This law is so self-evident that it hardly seems necessary to state it. Yet there has been so much confusion concerning the laws of

learning that we need to emphasize how simple as well as how few they are.

An interesting illustration of the functioning of the law of use is presented in the learning of typewriting. Professor Book studied the improvement in rate of typewriting as a result of practice. Figure 51 shows the rate of such improvement from day to day. In this connection it is worth pointing out that in general the most rapid improvement comes at the beginning of the learning process. After a time the law of diminishing returns generally functions, producing the typical negatively accelerated learning curve.

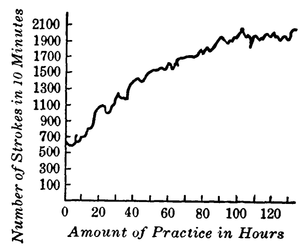

FIG. 51. CURVE OF IMPROVEMENT IN TYPEWRITING

This is a typical learning curve in that there is a rapid initial rise with a falling off in rate of improvement as practice continues. (From Book, *The Psychology of Skill*. Gregg, 1926.)

Although the form of the curve tends to be constant, the rate at which progress occurs varies for different persons and for the same persons when the material is of different degrees of difficulty. Furthermore, it is not to be understood from this description that the rate of improvement is constant and the curve of progress regular. Variations in rate occur from day to day causing fluctuations in the curve. Often in the learning there is a period during which there is little or no progress. These are called *plateaus*. These may be caused by a temporary loss of interest in the problem or by the fact that progress may depend upon acquiring a certain efficiency in some simpler process before some more difficult part can be learned. If learning is continued far enough, a final plateau is reached beyond which progress is impossible. This is called the *physiological limit*.

2. *The law of disuse.* The law of disuse is really the reciprocal of the law of use. Other things being equal, a neural pathway which has not functioned for some time offers more resistance than one which has functioned more recently. This is the principle which underlies forgetting. Ebbinghaus, a German psychologist, first made a careful study of the rate of forgetting. He used nonsense syllables and found that about 60 per cent of them were forgotten in the first twenty-four hours. The rate of forgetting became less rapid for longer periods. Others have studied the rate of forgetting with sense material, such as poetry. The same general principles hold with this type of material, except that the rate of forgetting is less rapid. (See Figure 52.) Motor learning, such as typing, is retained longer than most types of verbal learning.

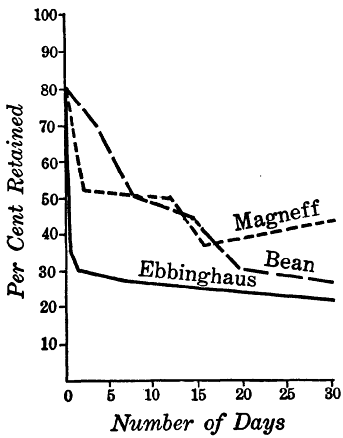

FIG. 52. CURVES OF FORGETTING FOR DIFFERENT TYPES OF MATERIAL

Ebbinghaus used nonsense syllables; Bean used series of letters; Magneff used poetry.

3. *The law of effect.* By the law of effect we mean that a response which produces a satisfying state tends to be repeated, and one which produces an annoying state tends not to be repeated. Although it may be very difficult to explain why the result, or state, which follows an act can have any effect upon the repetition of the act, the fact remains that it does.

Many practical experiences in everyday life bear testimony to this law. The child who likes arithmetic or piano playing, other things being equal, learns most rapidly. How slowly the child learns who has to be driven to practice each day! The same thing holds for adults. The woman who does not like to cook is not likely to make a good cook if she can find something else to do which she prefers. She will get a job and hire a cook.

There are several experiments which have proved that this law holds with lower animals as well as with man. Kuo constructed a maze for rats in which there were four different paths from the entrance to the food box. All of these paths led to the food, but in one pathway an electric shock was administered to the rat, and in another pathway the rat was confined for twenty seconds before it was allowed to proceed. There was no punishment or confinement in the other pathways, but one was three or four times as long as the other. The rats were started so that they had equal chances to go in any one of the four runways. At first they selected each pathway by chance about the same number of times, but in later runs they learned to avoid the path where they received the shock. Later still they ceased to go in the path which led to confinement. The long pathway was eliminated last. Gradually the rats had learned to get to the food by the shortest pathway without any punishment.

Recently the author performed a similar experiment in which there were four simple pathways, all of equal difficulty. No punishments were administered. But if the rat went into any pathway but the one which led to the food box, it was immediately returned to the starting point. If the rat went along the right pathway, it was fed. If the law of use fully explained all learning, the rats in this experiment would never learn to choose one pathway to the exclusion of the others. Yet the rats did learn to go to the box where they received food, and they soon went along this pathway to the exclusion of all the others.

The same thing holds for man. The salesman in making his rounds soon learns to go to the customers who buy and to eliminate those who do not buy. His only reason for returning to some who do not buy is the hope that they may become purchasers.

The law of effect is further illustrated in cases where the first experience in any situation is either very pleasant or very annoying. A child who has been frightened once by a dog may always be afraid of dogs. The effect of the one experience teaches the child to fear dogs. A person's like or dislike for another person generally depends upon some memory or experience in connection with the first meeting. These examples illustrate that one experience may have a profound effect in the learning process — an effect that cannot be explained on the basis of the law of use alone.

Professor Dunlap performed an interesting experiment which proves the converse of this law. He found that he rather consistently made mistakes in typing the word *the,* writing it *hte.* Dunlap deliberately wrote *hte* for about a page. Thereafter he found that he never spelled the word incorrectly. He did not enjoy the practice in writing the word incorrectly. As a result, practice with annoying consequences, instead of strengthening the process, caused its elimination.[1] This experiment leads to skepticism concerning much of our drill work in school and out. Drill with dissatisfaction may actually prove harmful.

Secondary Laws of Learning. In addition to the three primary laws of learning there are three others — the laws of primacy, recency, and vividness — which are called secondary laws.

1. *The law of primacy.* First experiences are more likely to be retained than later ones. This holds whether one is learning a list of nonsense syllables, a poem, or facts in an outline. The first item has a better chance of being retained than others in the body of the material. The same principle holds when

[1] It should be stated that this is not the explanation proposed by Professor Dunlap.

taken in broader perspective. An experience of childhood, other things being equal, has a better chance of being remembered than an adult experience.

2. *The law of recency.* Recent experiences are more likely to be retained than remote ones. This seems to contradict the principle of primacy, but they are supplementary rather than contradictory. You will be more likely to retain a memory of your first "date" than of subsequent dates. You will also remember the last one more clearly than intermediate ones. You can remember the first as well as the last word in a list to be memorized better than those in the middle of the list. Whether the first or the last excels cannot definitely be stated.

3. *The law of vividness.* Other things being equal, a vivid experience is more likely to be retained than those which are less vivid. A person may remember a train or automobile wreck which occurred some time ago as though it happened but yesterday. Similarly, certain events, such as graduation or a hard contest, stand out in our memories very clearly.

XXXIII. Variations in Complexity of the Learning Process

Because learning covers so wide a range from the simple forms to the complex ones of adult human learning, it may appear that the simple and complex forms are quite different in their essential nature. As a matter of fact, all forms depend essentially upon a permanent change in the nervous system through experience. Classified according to complexity, there are four types of learning: (1) learning by trial and error, (2) learning by observation, (3) learning by association, and (4) ideational learning.

Trial-and-Error Learning. The simplest type of learning is the trial-and-error learning so characteristic of the lower animals. This type may likewise appear in the learning of children as well as in some forms of adult learning. The essential nature of a trial-and-error reaction is that it is done before we know what we are doing or why we have done it.

The animal attacks a new problem with little insight into its nature or the methods by which it may be solved. The cat confined in a cage does not deliberate, but tries one and then another method of escape. Man uses a similar method in much of his learning. This we call the *trial-and-error method.* Chance success gives the right response, and then by a process of elimination the wrong methods are dropped. Improvement generally takes place during practice in the method adopted, and is brought about by the elimination of faulty or poor elements in the process and by the substitution of better methods, discovered by chance.

The solution of a puzzle illustrates this type of learning in man. A good puzzle is so designed that it deceives the person who attempts to solve it by leading him to trials of the wrong sort. If the person attacks it with little insight into its essential features and without logical analysis, he fumbles with it more or less at random until, to his amazement, it is solved. If he does not observe the movements that were the means of solving it, he may require just as much fumbling for the second solution as for the first. Usually the second solution, even if the first solution was a chance one, eliminates some movements which were not immediately connected with the solution, and so the time required for solving is somewhat shorter. Finally, when the person sees how he solved it, his learning shows a sudden improvement. Whereas, in the first trial, it may have taken him fifteen minutes to solve the puzzle, he may solve it the very next time in fifteen seconds. An extremely sharp improvement in one's learning curve usually indicates a change from the fumbling, trial-and-error type of learning to an insight into the nature of the problem. (See Figure 53.)

This type of learning is much more common than at first it might appear. It accounts for the so-called beginner's luck. The new golfer goes out with no clear notion as to the fine points of the game but in blundering along he may make some very fine shots. He is just as likely to make some very bad ones immediately afterwards because he does not know how he made the good ones. The new salesman may blunder into some wonderful luck, but if he is working on the trial-and-error basis, he will make a very irregular record. The novice in the stock market may make a fortune one week, but he is likely to lose it the next. The professional is the man who makes a consistent record because he has learned the principles of the work he is doing and is not relying on chance success. In short, the trial-and-error method is often good in the beginning of a task (it certainly is better than never attempting anything), but in human life it should be superseded as soon as possible by other more efficient types of learning.

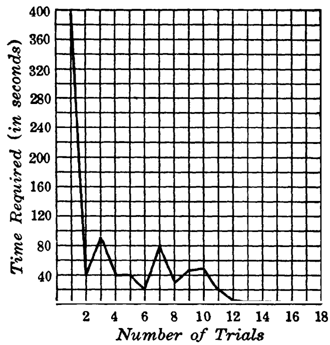

FIG. 53. CURVE OF LEARNING FOR THE TWISTED-NAIL PUZZLE

The first success came accidentally, but the method was noted, so that a marked decrease in time occurs after the first trial. In trials 6 and 11 an important principle was discovered which soon reduced the time to the physiological minimum. (Adapted from Ruger, *Archives of Psychology*. XV.)

Learning by Observation. In learning by observation there is some insight into the method of procedure before the act is begun. There is considerable question whether lower animals use this method. Thorndike found that one cat did not profit by watching another cat get out of a cage. On the other hand, Woodworth cites the case of a chimpanzee that watched another poke a banana out of a hollow log with a stick. Upon being released, the second chimpanzee immediately proceeded to imitate the first in his method of securing the banana. It is probable that some of the higher animals do learn by imitation. It is even more probable that most of the stories about imitation in animals are false.

Man certainly learns by observation. Language is largely acquired by this method. Coaches in athletics, teachers of vocal and instrumental music, instructors in shops, as well as parents, spend much time illustrating how to perform skilled acts. The benefit which the pupil gets from this instruction may be said to be gained through imitation. Thus described, imitation is no mysterious principle but only a name for one form of learning.

Learning by Association. In the two previous methods of learning there was a fairly direct connection between a stimulus and a response: that is, the emphasis was upon the motor element in the learning. In associational learning there is a greater elaboration of complex central connections and the motor component is usually confined to one type of expression — namely, words. Learning by association is a generally used method, but it is most effective when employed with connections which involve verbal reactions. It is by association that the child connects the names of objects with the objects themselves. The child learns to produce sounds by imitation, but he learns to relate the sounds to the objects by association. It is by association that the child learns to use printed symbols for spoken words. Foreign languages are also learned by association.

Ideational Learning. In ideational learning there is still greater elaboration of the central processes. For example, a person faced with a problem may manifest few or no specific responses for a long time but, during this interval, there may be great neural activity with only incipient or minor motor reactions. Mental multiplication of two numbers (23x56, for example) is an illustration of this type of learning. The way in which the child is trained in the processes which are necessary to solve such a problem shows the growth from one step in the learning process to the next. The child must, by trial and error, learn that two objects are more than one, and three more than two. If a young child is offered a block, he may take it with his right hand. When he is offered another, he will probably take it with his left hand. When he is offered a third block, he will probably drop the first or second one in order to take this third one. He will continue to drop one he has in order to take another as long as the game is interesting. He has little notion of the cumulative value of one, two, three, four, and so on. But by trial and error he learns. Then by watching others and by instruction he learns to relate numbers; he adds cars and makes a long train, he takes cars away and makes a short train. By associational learning he relates names to these number sequences. By a combination of trial and error, instruction, and associational learning he acquires the ability to add and subtract, multiply and divide. Finally, there comes the transition of all this learning from the motor side to the ideational side, and he is able to manipulate the symbols without referring to the objects.

He begins by adding and subtracting cars and blocks, is promoted to the stage where he adds and subtracts on his fingers, and finally learns to add and subtract numbers "in his head." The transition is sometimes difficult, as is evidenced by children using their fingers below their desks when the teacher is insisting that they use their heads and not their fingers.

Ideational learning forms the largest component of the process which we shall treat in a later chapter under thinking. Thinking is literally delaying a response until various possible solutions have been tentatively tried in imagination, with probably certain minor movements accompanying this imagination, and a final motor response to test the validity of the conclusion reached by this lengthy central process.

The four types of learning which have been described are not mutually exclusive but tend to overlap one another. The same general principles hold for all of them. The difference is rather one of degree. As we have pointed out, there is trial and error in reasoning and there is association in all forms of learning. Nevertheless, these divisions are useful in stressing the different factors in learning and in emphasizing the relative importance of each in different problems.

XXXIV. Methods of Economy in Learning

Enough has been said to show that all methods of instruction are not equally effective in learning. There is the further problem of how much instruction is best; that is, how much of learning should be a matter of the learner's working out his own salvation. A few of the more important methods for securing economy in learning will be listed and described.

Effect of Interest or Motivation on Learning. The law of effect has many practical applications in learning. Some of these applications have already been mentioned. The attitude of the learner toward his problem makes a great deal of difference in the success of his learning. With sufficient interest in improvement, progress is sure to follow. By this it is not meant that anyone can become anything that he wishes. We all have our limitations and these differ from one individual to another. The significant fact is that few, if any, of us reach the physiological limit. Men who have worked in a telegraph office for years and seemingly have become as nearly perfect as possible usually improve when given a better and more responsible position, such as press dispatching.

Many industries have discovered that even a slight increase in salary or improved working conditions has produced a decided improvement in work. This is a very important fact when we consider the all-too-common irritations that exist between labor and management.

Professor Book trained two groups of college students in some simple problems involving associative learning. The students were divided into two groups of approximately equal ability. One group was motivated by being allowed to record their own progress. The other group worked without knowing

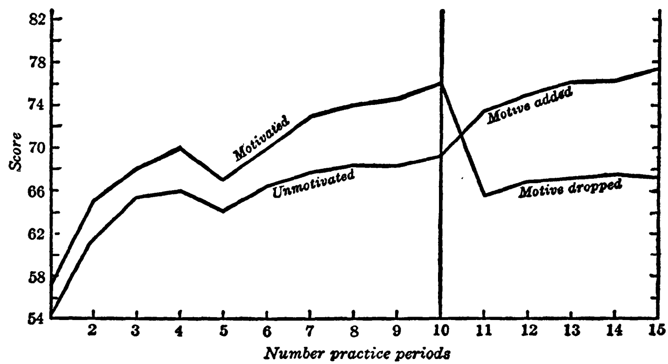

FIG. 54. THE INFLUENCE OF MOTIVATION ON LEARNING
(Adapted from W. F. Book, *Pedagogical Seminary,* Dec. 1922.)

their rate of progress. After ten practices the procedure was reversed and those who had been motivated by watching their own progress were not allowed to do so thereafter, and vice versa. The result was that the motivated group in the first part of the experiment lost their advantage over the other group, while the second group suddenly gained an advantage upon receiving the motivation. We may summarize by saying that interest and knowledge of results are factors favorable to maximum learning. The results of Professor Book's experiment are illustrated in Figure 54.

Effort Facilitates Learning. Common observation, as well as controlled experiments, indicates that we learn more when we try. When we are alert, our sense organs are ready to receive impressions, our motor organs are all ready to respond, and the neural connections are more ready to function.

Effort is generally closely related to interest. In order to bolster up both interest and effort, we should form a habit of doing whatever we do with all our might. When we work we should work, and when we play we should play with equal energy. We are all prone to be satisfied too easily. If we had some method of measuring effort, we should probably be able to separate the successful men as a group from the unsuccessful.

Good Working Conditions and Learning. Good office conditions and good factory conditions are essential to maximum efficiency. Such things will not in themselves produce results, but good results can hardly be secured without them. A study of successful businesses will show that there is a high correlation between working conditions and efficiency.

Morgan has shown that certain distractions, such as noises, may actually increase output. At the University of Oregon a few years ago an experiment was conducted in which two groups of equal ability were given the same examination. One group was subjected to various distractions, such as the flashing on and off of a strong light, a medley of discordant noises, and men walking heavily on the floor above. Yet this group made a better score than the group working without distractions. If, however, we could measure the energy expended, we should probably find the clue to the difference between the two groups. Although such tests may suggest a value in distractions, such a method of increasing mental output is false economy, if not a source of danger. We should not need a distraction to produce greater effort.

The Length of the Work Period. There are two parts to this problem. One concerns the length of working hours during the day and week, and the other the distribution of work and rest periods during the day.

The history of industrial progress since the Middle Ages has shown successive reductions in the hours of work. In early times men worked fifteen and even eighteen hours per day for six or seven days a week. This amount has been gradually reduced until there is now a rather uniform eight-hour day, and in many industries even a five-and-a-half-day week. And this has taken place without a reduction in output. Watts gives the following: "In one British factory during the war a decrease from 58:02 to 41:02 in the average hours worked weekly was accompanied by an increase of 22 per cent in the output (sizing fuse bodies). In a second munition factory a decrease from 66:09 to 45:06 in the average hours worked weekly by women workers in turning aluminum fuse bodies resulted in an increase of 9 per cent in the output. In a third factory there was a fall of just 1 per cent (milling screw threads) when the average hours worked weekly were reduced and fell from 64:09 to 48:01. The loss in this case, however, was more than counterbalanced by the saving in factory lighting and the wear and tear of machinery."[1] Muscio says: "A large firm with shops both in Lancashire and in Belgium found that on identical work the output per man was greater in Manchester with its fifty-one-hour week than in their Belgium factory, where the week ran to sixty-six hours."[2] The same type of results has been found in other countries and in time of peace as well as war. Of course there is a limit to the amount of reduction in the hours of work. Too much leisure is not necessary or advisable. We have yet to discover the optimum time for each industry.

[1] Watts, Frank, *An Introduction to the Psychological Problems of Industry*, p. 30. Copyright, 1921, by The Macmillan Company. Reprinted by permission.

[2] Muscio, Bernard, *Lectures in Industrial Psychology*, p. 67. Dutton, 1920.

There is the further problem of the best distribution of time of practice or work. Given a certain amount of time, what is the most effective distribution of it? Should all the time be spent in one practice or should it be distributed? Manifestly this is related to the time to be spent. If only fifteen minutes are allowed, probably one sitting is more efficient than two or more. On the other hand if twenty-four hours are to be devoted to a task, the time should be distributed. Just how it should be distributed is another question. The answer depends upon the nature of the task and the person performing the task. If the task is some difficult job, the time should be shorter per work period than for an easy job. A few minutes per period is enough at stoking a furnace.

A child cannot work continuously for as long periods as an adult. Kirby seemed to find that two-minute practice periods in drill in the fundamental operations in arithmetic were most advantageous. Pyle found thirty minutes to be the best period for adults in the rather difficult task of substituting abstract symbols for the letters in words. Manifestly, older children and adults may practice longer.

There is the further related problem of whether there should be several practices in one day or longer rests between practices. Work with both rats and men seems to show the best distribution of periods to be daily or every other day.

There are probably individual differences in periods of maximum efficiency and distribution of periods. The problem is closely related to that of fatigue. As yet we can only generalize by saying that each person has the problem of discovering his best method of work for each type of task. A word of caution is necessary: a first feeling of fatigue, especially with routine work, is not a sure index of a reduction in efficiency.

The Teacher as a Factor in Learning. The value of an efficient teacher has already been mentioned. There is a good deal of discussion these days about self-education in the course of which the teacher is often discredited and his place in the educational scheme discounted. It is true that education is an active process and that the student must do the learning; yet there is a real place in our educational system for the teacher. The best products of education generally come from the schools with the best teachers. At best self-education is wasteful and at worst it is likely to give wrong methods and results.

Professor Carr has studied the value of instruction at different periods in the learning process. He has found that it is just as easy to instruct too much as not enough. He further found that more instruction should come at the beginning of the learning and that a smaller amount should be given as learning progresses. The conclusion seems to be that too much teaching is to be discouraged as well as too little.

Learn by Practicing the Thing to Be Learned. How much will training in one subject help in other subjects? Some of the earlier psychologists contended that training was general and was transferred from one subject to another. This doctrine is known as *transfer of training,* or *formal discipline.*

According to this theory, learning to operate a typewriter should help one when he attempts to learn telegraphy or to play the piano. Solving a puzzle should help him to perform in a maze. Playing tennis should make one a better football player or a faster swimmer. In these fields there is probably some transfer, for exercise of the fingers in one activity should make them more agile in any other type of activity. Athletic skill should improve one's bodily control and make one more efficient in some other sport.

This doctrine, however, went farther and contended that any kind of learning or training would help in totally irrelevant fields. It was applied most vigorously to academic subjects, and its votaries held that a study of Latin, Greek, and mathematics would make one a better telegraph operator, a more skilled mechanic, a better physician, or business man.

About 1890 William James performed an experiment in learning by committing lines from Victor Hugo's *Satyr* and then committing from Milton's *Paradise Lost*. He then went back to Hugo's poem in order to determine whether he could commit more rapidly than the first time. He did not find that the practice on *Paradise Lost* improved his rate of learning Hugo's *Satyr*.[1] For many years the result of this experiment was accepted by many as proof that there is no such thing as transfer of training.

Both extreme views regarding transfer of training are held. That training in one subject helps in the study of another has been held largely by language and mathematics teachers; that there is no transfer of training has been held by psychologists and teachers of education.

Within the last twenty years many experiments have been conducted to throw light upon this problem. Some of these showed a great deal of transfer and others little. Some showed negative transfer; that is, practice in one task actually hindered work in another task. While there is diversity in the results, we may summarize by saying that the nearer two things are alike, the more transfer there will be. If the two were identical, theoretically there would be one hundred per cent transfer. If they were completely unlike, there would be no transfer. If performing one task were just the opposite of performing another, there would be negative transfer.

The best way to learn anything is to practice on it, not on something similar to it. Even sorting cards has been found to improve slightly one's ability in typing, but if one wants to learn typing, he had better practice typing rather than sorting cards or anything else.

[1] James, Wm., *The Principles of Psycholcgy,* Vol. I., pp. 666 f. Holt, 1890.

XXXV. Habit Formation

Learning may progress to such a degree that the resultant behavior will be almost as automatic, precise, and instantaneous as a reflex. These fixed behavior patterns which have been learned are called habits, and may range all the way from simple motor responses to such complex attitudes as hatred, laziness, patriotism, or one's philosophy of life. Habits have the advantage of simplifying many phases of our lives; but at the same time they have the disadvantage of virtually enslaving us to types of behavior which may be socially undesirable. By following certain rules, one may control his habits and even free himself from unfortunate ones.

Wide Range of Habits. Certain phases of the learning process have received special attention. This applies particularly to acts of skill and problems of moral conduct. Learning in these fields is generally called habit formation. We also tend to restrict the term habit to those motor responses which concern the whole organism. We form habits in learning to play tennis or in smoking. On the other hand, the terms *habit,* or *habit formation,* and *learning* are frequently used interchangeably. Habit is the result of learning. We learn habits. Habit formation is learning.

As we have said before, the lower animals and the child at birth exhibit only unlearned behavior. As we go higher in the animal scale or as the child grows older, learned responses become more and more prominent. The more intelligent the animal or man, the more likely he is to have a wide range of habits. Modern man is so largely controlled by habits that he is likely not to realize their number or importance.

Practical Effects of Habit. Man may get up by habit at a certain hour, dress by habit, and eat mostly as a matter of habit. He goes to work by habit and most of his conversation is habitual. Let us now consider some of the practical effects of habits.

1. One of the most important consequences of a habit is that *it reduces the amount or changes the direction of conscious attention to an act.* When we are learning to run an automobile, to typewrite, or to play golf, we must give our painful attention to each part of the process. As we become more habitualized to the process, attention to details becomes less and less important, until we need to be conscious of the act only at the start. Handwriting has become almost entirely automatic with most of us. The expert typist can carry on a conversation without stopping his work. In fact the expert is not likely to do so well when he thinks of each part of an act as he does when he performs the act automatically. He does not do it the same way. This is one important reason why some good athletes do not make good coaches.

In such games as golf we see another example of the gradual elimination of consciousness. As we have already intimated, the novice must give attention to each part of an act as it is being performed. At each step in the process, as practice continues, smaller parts of the act are combined into larger wholes. The attention is then directed to these larger parts. After years of practice the expert golfer automatically takes the correct stance and gives his attention only to the ball and the green at which he is shooting.

2. The second practical effect of habit is that *it reduces fatigue.* It is the first game of the season that tires the players the most. The man who begins some difficult task in industry is easily fatigued the first few days. After he becomes accustomed to the task, he gets along very satisfactorily. The reason for this is not hard to find. As we practice, we become more proficient and therefore use up less energy. Furthermore, before a habit is fixed, nervous energy is consumed not only in stimulating the muscles which make the correct movements, but in contracting other muscles, some of which may be antagonistic to the desired movement. In the case of mus-

cular effort the muscles themselves become hardened to the new task.

3. The third effect of habit is partly included in the second. *Habit simplifies our movements.* We need only watch a man learning to play a new game or a beginner on some new machine to see an illustration of this effect. The trouble is not so much that such persons make too few movements (more often they make too many), but they are not the right movements or are not made at the right time. Mr. Frank Gilbreth conducted an experiment in which he placed small electric light bulbs, with flexible cord attachments from a battery, on the hands of machine workers. He then photographed the movements of the workers' hands in doing a routine task. Ten repetitions of a task performed by the skilled workers could be photographed one upon another and the record could hardly be told from the record of a single performance; that is, all ten were practically the same. But when the movements of a novice were photographed, each performance was different from all the others. As Gilbreth well said, there is one best way to do each act. The skilled workman tends to approach this best way, but even the expert may be able to improve on his old methods. The novice has no method. He performs each act differently. It is only by long, painstaking trial and error that he learns an efficient method of work.

Age Differences in Habit Formation. William James many years ago pointed out that most of our personal habits are formed by the age of twenty. He says:

> The period below twenty is important . . . for the fixation of *personal* habits, properly so called, such as vocalization and pronunciation, gesture, motion, and address. Hardly ever is a language, learned after twenty, spoken without a foreign accent; hardly ever can a youth, transferred to the society of his betters, unlearn the nasality and other vices of speech bred in him by the associations of his growing years. Hardly ever, indeed, no matter how much money there be in his pocket, can he even learn to *dress* like a

gentleman born. The merchants offer their wares as eagerly to him as to the veriest 'swell' but he simply cannot buy the right things. An invisible law, as strong as gravitation, keeps him within his orbit, arrayed this year as he was last; and how his better-clad acquaintances contrive to get the things they wear will be for him a mystery till his dying day.[1]

Even in more intimate affairs than clothes and language our habits are formed early. We form the habit of reacting to people. We form habits of social relations that make us either very agreeable friends and companions or the opposite. Our emotional behavior becomes largely a matter of habit. We develop happy or sad dispositions by habit. Swearing is largely a matter of habit. Statistical studies have shown that more than half of those who join a church do so before the age of sixteen. Other kinds of moral conduct become habitual. We learn to be prompt or late in our engagements, to be truthful or to lie. In fact so little of our lives is more than habit that we may with some truth speak of a man as a bundle of habits.

During the late teens and early twenties we are busy forming our professional habits. Although the rewards may not come until later, our ultimate success or failure depends largely on the habits we form in our early professional experience.

There is considerable difference of opinion and practice in the matter of how early these specific professional habits should be formed. Some industries, especially the railroads, and some commercial organizations have stressed the importance of an early start. Biographies, and especially autobiographies, are replete with instances of office boys who have become presidents of their respective organizations. Such men are sure of the importance of their early professional experiences.

Others, equally successful, have stressed the importance of a broad, general foundation before entering industry. The professions, especially medicine, require a long period of train-

[1] James, Wm., *Psychology, Briefer Course,* pp. 143–4. Holt, 1923.

ing. While such training is related to later life work, it does not consist in actual experience in surgery, materia medica, and clinical practice. Proponents of this theory point to the large proportion of successful college men in both industry and the professions. While the point may be well taken, it is possible that at least part of the success of the college group is due to their superior ability and not entirely to the results of their training. Nevertheless it is probably true that the kind of training received in college is conducive to clearer thinking and a more cosmopolitan interest in things worth while. Further than this the difference between the two points of view is not clear.

Whether the training starts early or late, the final results are of the same kind. To quote again from James:

> Already at the age of twenty-five you see the professional mannerisms settling down on the young commercial traveler, on the young doctor, on the young minister, on the young counsellor-at-law. You see the little lines of cleavage running through the character, the tricks of thought, the prejudices, the ways of the 'shop' in a word, from which the man can by-and-by no more escape than his coat-sleeve can suddenly fall into a new set of folds. On the whole it is best that he should not escape. It is well for the world that in most of us, by the age of thirty, the character has set like plaster, and will never soften again.[1]

There is considerable truth in these statements, although they are somewhat exaggerated. It is true that most of our habits are formed in early life. Yet when the occasion arises, a man can form habits late in life. Through death in the family or through disaster, a person may suddenly be thrown out of the regular routine of life. Under such circumstances, although it requires considerable mental strain, the average individual learns to adjust to the new situation. The reason that

[1] James, Wm., *op. cit.*, p. 144.

most persons do not form habits late in life is that their lives have already become habitualized and no unusual circumstances make it necessary for them to change. Professor Thorndike has shown that learning ability continues with little loss until well after middle life.

Good and Bad Habits. It has often been claimed that it is easier to form a bad habit than to form a good habit. Such is not the case. One is just as difficult as the other, *per se.* The general laws of learning hold in either case. Practice, plus the degree of satisfaction or annoyance, fully accounts for all habits. The reason boys learn to smoke and to swear is that they practice these things and get a great deal of enjoyment from them. If the boy gets just as much joy from mowing the lawn or studying his arithmetic and works at it just as hard (as he will do if he likes it), he will learn that thing as readily as anything else. It is most important that we set up significant values and standards of attainment for our youth. Too often the immediate and the mock heroic are substituted for the real and the enduring things in life. And the elders are generally, although unintentionally, the cause of these substitutions.

James's Laws of Habit. William James in his great contribution to the problems of habit formation has laid down four maxims, or laws, of habit formation.

1. The first of these is: *In forming a new habit, launch yourself with as strong and decided an initiative as possible.* No new enterprise, either personal or social, is achieved by a half-hearted appeal. This law is a justification for initiative ceremonies or pledges. Such a start is likely to fortify one against the dull drudgery or vain cravings of later days. This is not a new principle in psychology. It is the same phenomenon as purpose, or motive, described by Woodworth. A motive consists in a change of a longer or shorter duration in the resistance of a pathway. The stronger the motive, the lower

the resistance, and, other things being equal, the longer it will last.

2. The second law is: *Never suffer an exception to occur in the formation of a new habit.* Especially in the early stages of a habit, one exception will destroy the effects of several practices. This may seem contradictory to the law of *use* in learning, but it is closely related to the first law of habit. One relapse breaks down the motives in the formation of the habit. It is so easy thereafter to say, "Oh, what's the use!" If this attitude is taken, all is lost. It is the first drink taken after the decision to stop that breaks the new habit and reëstablishes the old.

This illustrates the method of destroying any habit, good or bad. *We destroy a habit by forming another habit in its place.* If you have formed the habit of paying no attention to the alarm clock in the morning, have some one awaken you rather rudely for a few mornings the first time it rings, *and then get up immediately.*

3. The third law is: *Seek the first possible opportunity to act upon a new resolution.* The best time to make a New Year's resolution is now, whether now is January third or December twenty-sixth. And the best time to put the resolution into practice is immediately upon making it. It is usually fatal to put off until New Year's day the promptings of the moment. Delaying until tomorrow is an effective way of failing to begin the new habit. The reason we delay is that we really do not want to change. If you resolve that you are going to attend church, lodge, or professional meetings more regularly, look up the date of the next meeting that is to be held. Then allow no excuse to keep you away.

4. The fourth law is: *Keep the faculty of effort alive in you by a little gratuitous exercise daily.* This is the most difficult of the laws to justify on psychological grounds. Yet it is certainly worth trying. The principle embodied in this law makes

the distinction between youth and old age. When we regard all our problems as solved and place each new problem into some old category, thereafter dismissing it without further concern or effort, we have grown old. That is the criticism that modern youth is holding so effectively against the tenets of our present civilization. Their constructive measures may not be better or even so good as our own, but by such means will progress come. Progress comes only when we do everything we can both collectively and individually to keep an open mind.

There are many acts that should be relegated to habit. We should not spend much time and energy in determining what we shall eat and wear each day. But the great problems of religion, politics, and business should stimulate us to mental effort. We should not, of course, unthinkingly abandon the heritage of the ages. The past should be duly respected and preserved until we are sure we have something better. But religion and politics are ever in process of evolution, ever reaching for higher goals, and with progress must come changes in our thinking. Life is a continual struggle between the tendency to relegate everything to habit — to become "old fogies" — and the tendency to remain young enough to make new adjustments — to remain plastic.

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CHAPTER VIII

MEMORY

XXXVI. The Place and Significance of Memory

Memory is a special form of the learning process in which the verbal components are more significant than are other types of motor response. This chapter is an elaboration, therefore, of the complex types of learning mentioned in the last chapter as associational and ideational learning. The fundamental principles of memorizing are no different from learning in general, but the increase in complexity makes a special study of memory essential. As we enter the more complex phases of life, memory plays an increasingly important rôle. We may divide our study of the subject into four main sections: recognition, fixation, retention, and recall.

Economy of Verbal Symbols. Words are essentially short cuts and, as such, save man an inestimable amount of time and energy. We respond to the name of an object we have learned just as readily and effectively as to the object itself. By using the names of acts, we tell a person what we want him to do instead of showing him. By words, such as *above, right, north, within,* and the like, we indicate relationships which would be extremely difficult to convey by any other means. We classify by means of verbal expressions of likeness and difference and then utilize the classification further by building up abstractions and principles to guide our conduct. Could we, for example, without the use of verbal symbols ever come to a realization or practical application of such a useful principle as: The hypotenuse of a right-angled triangle is equal to the square root of the sum of the squares of the two legs?

It will help us at the beginning of our study of memory to examine the interrelation of some of the processes concerned in it. Suppose, for example, that for the first time in our lives we saw a cow. Even if we were not given a name for it, we should recognize it the next time we saw it. We should have a feeling of familiarity. This is the simplest type of memory and will be treated in the discussion of recognitive memory. If a verbal symbol was used in connection with the cow, we may be able to call up a memory of the animal when the name is mentioned; that is, we may imagine a cow, or when we again see a cow, we may be able to remember the name *cow*. This latter process is called recall. Recall, in this case, is dependent upon the degree of fixation between the animal and the name, and upon the ability of the individual to retain such a connection after it has been established.

This illustration indicates the relationship between the phases of memory that we shall study. Recognition is a mere vague feeling of familiarity, fixation is the process by means of which this familiarity becomes specific and related to some verbal symbol, retention is the degree of permanence of the connections established, and recall is the process of bringing into active functioning some connection which has been fixated, or established, by previous experience.

XXXVII. Recognition

Where the residual effect of some experience is non-specific, we have recognition. In such situations as do not require specific reactions, recognition is valuable. Where some specific reaction is essential, it should develop into recall. Finding our way, responding to casual acquaintances, enjoyment of music, and measuring the effect of advertisements are some of the situations in which recognitive memory may be of service.

Nature of Recognition. During life we are continually reacting to situations as a whole with little or no conscious attention to the specific details which compose the whole situation. This is highly efficient because if we tried to notice every detail of every situation, we would soon be confused, lost in a maze of irrelevant factors. Upon reëxperiencing a situation to which we have responded only as a whole, we have a feeling of familiarity; we are aware that we have been there before or we have seen that person; but we cannot cite any specific detail, or at least not a sufficient number to convince ourselves or others of the identity of the two experiences. *This memory of an experience as a total pattern is known as recognitive memory.*

Use of Recognition. Having once driven along a road, you may feel certain, on a future occasion, that you are on the same road, although you cannot tell upon what factors you base your judgment. You feel sure you have seen a certain person before, but you cannot tell whether it is his hair, eyes, nose, or clothing upon which your recognition is based. In short, recognition makes orientation to our environment a rather simple process. We may say that it gives meaning to our experiences by means of the same principles as are operative in the process of perception.

There is little doubt that music is more pleasing to us when we recognize some air, rhythm, or harmony in it. We cannot, many times, tell just what it is nor could we reproduce it, but we enjoy it because of the familiarity.

In legal practice the validity of recognition is credited when a person is asked to select from a group of persons the one whom he saw entering a house, boarding a street car, or engaged in a fight.

Recognition of Faces and Recall of Names. Recognizing a face is obviously an easier process than recalling a name. The latter is a specific connection requiring adherence to the principles of recall, which we shall consider in a moment. Recognition requires only the most general type of experience.

Consequently, when a person makes the statement that he can remember faces but not names, he is merely uttering a commonplace. When you tell a person that you recognize him but cannot remember his name, you are, in effect, telling him that he made but a vague impression upon you. To be sure, he must have made more of an impression than if you had not remembered him at all, but to tell him that you merely recognize him is a sort of "left-handed compliment."

There is a very good reason for our common inability to remember names. Generally, when we are being introduced to an individual, we are judging the person, forming our first opinion of him, and deciding whether we shall like or dislike him. Our attention is not directed toward the name, but rather away from it. Furthermore, the introducer often does not pronounce the name distinctly. The whole situation, therefore, is not conducive to remembering the name.

If we wish to improve our ability, we should pay particular attention to the name when we are introduced, and inquire what the name is if we do not understand it. Then we should avail ourselves of every opportunity to use the person's name while we are talking with him. If we are particularly interested in remembering the name, it may be advisable to write it down as soon as the interview has ended.

Many salesmen find it valuable to keep lists of their customers and to review these frequently. Such a salesman, before visiting a group of customers, will carefully go over the list of names to be sure he remembers each person. Significant facts about each person — his appearance, his tastes, his favorite sports, his probable reactions to the sale involved — if added to the list of names, will greatly increase the value of such a device.

The author once knew the wife of a college dean who had a reputation for remembering the names of students and faculty members in the university. She explained that she spent much time in studying the student directory. When invited to a party by any group, she studied the list of names of those who were likely to be there. She noted their home addresses and other pertinent facts about them. This was simply an intelligent way of becoming socially efficient.

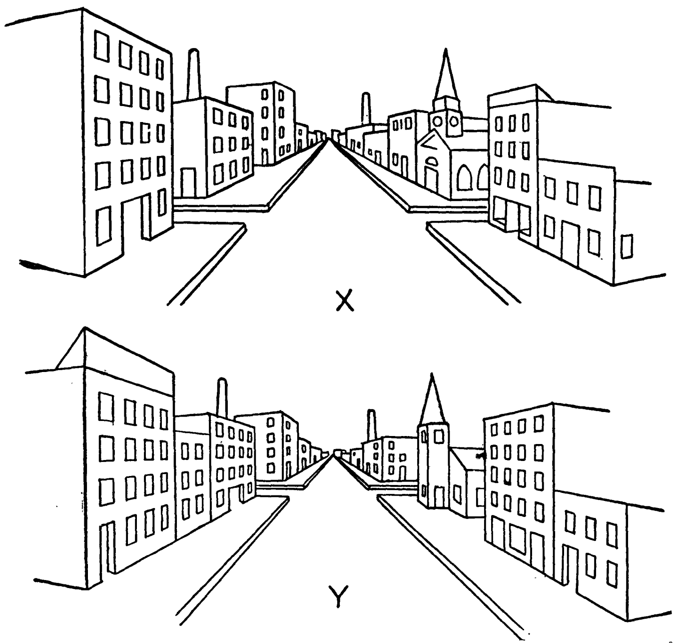

FIG. 55. ILLUSTRATION OF ERROR IN RECOGNITION

Scene Y may easily be mistaken for Scene X because of the presence of similar elements.

Errors in Recognition. We have all had the experience of recognizing a person or situation only to discover, to our embarrassment, that we were in error. We give a man a familiar slap on the back only to discover that he is not a friend but a stranger. We feel sure that we have been in a city before when we have evidence that we never have been there before.

Such situations usually result from the fact that the general impression is the same as in the previous situation which gave rise to the recognition. The identifying details have been ignored in each case, and we have responded to the whole pattern. Figure 55 illustrates how this situation may occur. The two scenes are alike in general effect and it requires specific analysis to distinguish them.

The fact that such errors may be made does not argue against the value of recognition. The number of such instances is small and their consequences unimportant when compared with the number of times we are benefited by accurate recognition. Repeated experiences with the same person or situation naturally enable us to become aware of more and more details until our memory is specific and we can indicate minute differences. In other words, we begin with recognition and gradually, in situations which are repeated often enough to warrant it, develop memory for details, thereby passing from the level of recognitive memory to that of recall.

Recognition Value of Advertisements. In the psychological laboratory a very simple means of measuring the recognition value of various stimuli has been developed. In serial order ten geometrical forms, portraits, words, or other stimuli are shown to the subject, each being exposed for only a few seconds. These ten stimuli are then mixed in random fashion with an equal number of similar objects which have not been shown, and the subject is required to identify the ones he has seen.

Modifications of this technique have been used to study the effectiveness of advertisements. A number of advertisements are first shown in serial order and later presented with other advertisements which were not in the first group; then the subject attempts to identify those he has seen. Obviously, the good advertisement is the one which is most often recognized. Another method is to have a person casually leaf through a magazine, and later select from a large group of isolated advertisements the ones he has seen in that particular magazine.

The theory underlying such experimentation is that if an advertisement possesses recognition value, it will, upon repeated presentations, lead to greater familiarity and eventually to recall. Thus the chances that the individual will purchase the advertised article are increased.

XXXVIII. Fixation

The principles involved in the fixation of verbal material are the same as those described in learning. The difference in the nature of the verbal material makes certain techniques effective which do not apply to motor learning. It is with a discussion of these specific techniques that we shall be interested in this section.

General Laws of Memorizing. In memorizing we use the various kinds of learning described in the last chapter; we learn by substitute stimuli, by substitute responses, by combination, and by the fixation of random responses. These principles govern the nature of the first verbal connections, as well as later intricate verbal combinations. The laws of use, disuse, and effect determine which of the verbal relationships shall become permanent, as well as the degree of permanence. In addition to these general principles there are specific ways in which the fixation of verbal material may be facilitated, and it is with these techniques that we are now concerned.

Specific Rules for Memorizing. If one is to make the most effective use of his memory, he should carefully analyze the use he wishes to make of the material to be memorized, and then apply the principles which best fit his need.

1. *Memorize with a specific purpose.* We sometimes hear of a memory prodigy who can tell all the numbers on a train of cars which has just passed, or relate a great many facts about historical characters which one would expect to find only in an encyclopedia. The author met such a prodigy in 1909. At that time the young man could give the exact population of every city of more than ten thousand inhabitants in the United States, according to the census of 1900. Three years later, when the author saw him last, he could give not only the aforementioned figures, but also the corresponding figures of the 1910 census. In other respects the young man was not exceptional; in fact he was unable to pass the examination for an elementary-teacher's certificate even after many trials.

Such performances appear marvelous, and we are inclined to wish we were so gifted. Investigation usually shows that these persons are not particularly gifted, but that they spent a vast amount of time and energy in acquiring this material or in developing the scheme that enables them to do it. The normal man does not want such a memory. If you are in a position where you need to be a walking encyclopedia, it will pay you to acquire facts as such; if you want to be a vaudeville performer, it may pay you to develop a lot of apparently clever performances; but if you are the ordinary man, you will want to use your memory on different occasions in different ways. So in each instance it may pay you to ask just what you would like your memory to do.

Before undertaking to memorize, it is advisable to determine whether the material is to be learned for permanent use, limited recall, or immediate recall.

(*a*) *Learning for immediate recall.* When we learn only for immediate recall, it is just as desirable that we forget quickly. We look up a telephone number and retain it long enough to get the connection, but if we know we shall never want to call that number again, or at least not soon, we do not want to retain it indefinitely. It would become a nuisance to us if we did. We start to read an article in a magazine and find that it is continued on page 76. We wish to retain that number long enough to find the page, but we do not want to remember to our dying day that the particular article was continued on page 76. A great many events in life are of this order. Do not let any memory charlatan cajole you into wishing you could remember everything. Life would be a burden if you did.

On the other hand, it may be valuable to increase the number of elements you can retain for immediate reproduction. The average adult can reproduce after one repetition about eight or nine discrete digits or about twenty-five syllables of material which has meaning. It has been found that even much practice will not enable us to increase greatly the number of discrete elements that can be repeated after one hearing, but the most effective method of producing an increase is to make such material meaningful. Meaning can be introduced in various ways.

Sometimes rhythm will enable us to repeat more digits than we otherwise could. For example, 473598312956, which is far beyond the ordinary memory span, might be reproduced if it were grouped and read as 473–598–312–956. Such a procedure is virtually reducing the whole number to four discrete units, each of which, to be sure, is rather complex.

Specific meanings will enlarge our immediate memory still more. If each digit is taken separately, such a number as 149252386728 is beyond the ordinary memory span. But, 1492 is the year Columbus discovered America, 5238 is a telephone number with which the author happens to be very familiar, and 6728 is the house number of the author's brother. With such meaning the series can be retained indefinitely.

Most schemes that improve immediate memory operate upon some such principle. They furnish devices, more or less valuable, to enable the subject quickly to read meaning into what would otherwise be a nonsense series of discrete items. Such devices are of value only where it is desired either to increase the length of the immediate memory span or to make a permanent impression with what would otherwise soon be forgotten. Furthermore, they generally apply only to rote learning, such as committing poetry, speeches, or outlines. They seldom are effective in helping one to remember the important facts in something which has been studied or the abstract principles necessary for constructive thinking.

(*b*) *Learning for limited recall.* By referring to Figure 52 it may be seen that forgetting proceeds very rapidly at first, and then more slowly. The significance of this fact is apparent when we are confronted with the task of learning material which is to be produced at a definite future date. If my last practice is a week before the time for reciting, I shall have forgotten the larger part of what I learned. It will pay in such a case to have my last practice as near as possible to the recitation period.

This is the principle upon which the well-known practice of "cramming" is based. Students have learned that it pays to refresh their memories just before they are to be examined. Obviously, a large part of such crammed material will have disappeared shortly after the examination. However, if the student's primary purpose is to pass the examination, this is the way to do it.

If the student puts too much faith in cramming, he will find himself confronted with another fact which will result in his discomfiture. There is a limit to the amount that can be memorized at one sitting, and usually this amount is much smaller than that included for any examination. The same thing holds when one has to make a public speech, read a poem, or do any other task involving memorizing. There is usually more than one can learn in one practice period; hence, if one tries to defer the entire learning to a time immediately preceding the delivery, he will find himself in hopeless confusion. The solution is to distribute the practice over periods preceding the delivery until it is fairly well learned, and then to have a final practice immediately preceding delivery.

(*c*) *Memorizing for permanent use.* It is possible to learn some things so intimately that they are never forgotten. One should endeavor to have as permanent memories those things which he finds most occasion to use. To accomplish this, three things should be done: (1) distribute the practice over a relatively long period of time, (2) overlearn, and (3) develop as many relationships with other things as possible.

Many experiments have demonstrated the utility of distributed practice when one wishes to retain material permanently. Ebbinghaus, a German psychologist, found that 38 repetitions distributed over three days was as effective as 68 repetitions confined to one day. What one is doing when he distributes his learning can be understood by another reference to Figure 52. Suppose the material is learned so that it can be repeated once. At this stage in the process, the curve of forgetting takes a sharp decline. But beyond this decline there is a residuum of memory for the material which remains for a long time, as is shown by the comparatively level portion of the curve. If, at the period represented by the beginning of this level portion, the material is relearned so that it can be repeated once more, another curve of forgetting is superimposed upon the first, the level portion of which is above the level portion of the first curve. If, after the major drop in this second curve, the material is again relearned, a third level of permanent memory will have been established. The result of such learning is illustrated in Figure 56.

This is what we mean by overlearning. By learning and relearning we fix the material in our memories more thoroughly than is absolutely essential for its reproduction. At last it becomes a part of us. We have all, for example, overlearned our names. For the child, learning one's name is a difficult task. At first he learned it and forgot, and then learned it again, repeatedly. As he grew older, he overlearned it by using it on

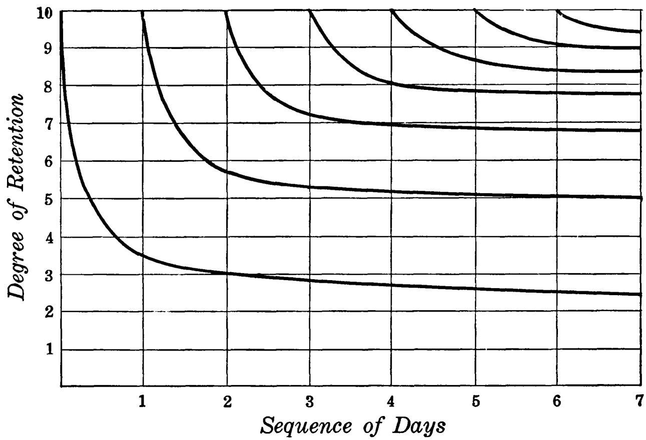

FIG. 56. SHOWING HOW OVERLEARNING MAY OPERATE TO INCREASE PERMANENT RETENTION

This schematic representation is deduced from a study of the curve of forgetting. If material is learned so that it can just be reproduced perfectly immediately afterward, at the end of one day only 34% of it will be retained. If it is then relearned, 56% of it will be retained at the end of the second day. With relearning each day the percentages retained will increase, so that by the end of the seventh day 94% will be retained.

all sorts of occasions, until it became so much a part of him that in adulthood something radical must happen to him in order to make him forget it.

The third factor in permanent memorizing, that of forming all the relationships possible, is perhaps the most important. It will be discussed in detail when we take up the problem of recall. In rote memory, when the purpose is the exact reproduction of the material learned, repetition is an essential factor in learning. One repeats the material over and over again until serial connections are established. By this method meaningless material, even nonsense syllables, may be memorized, but it can be reproduced only in the manner in which it was learned. For permanent memory, all sorts of collateral connections should be established, so that the relationship of each part with other things in life is made a part of the memory. In short, the permanent value of any acquisition is measured by the number of collateral relationships that have been established. The author, for example, heard two persons who had been abroad during the summer give a recital of the interesting events of the trip. One was full of accounts of the new things he had witnessed, and furnished his auditors with a delightful experience in listening to him. The other was exhausted when he had said that it was foggy in London and that he nearly froze in Italy.

2. *Vivid impressions last longer.* In many instances the factor of vividness is not within our control. Many vivid experiences which have made a deep impression upon us we may wish could be effaced. We may have witnessed a terrible accident which we shall remember to our dying day. We may have a vivid recollection of the perfidy of one we had thought to be our friend. Vivid war experiences make it inevitable that France suggests to many men nothing but mud, swearing, death, pain, hunger, and "cooties." If we could only make desirable experiences as vivid as these unpleasant ones, how remarkably efficient we could make our memories!

While we may not be able to make all worthy items in our lives stand out with the vividness of an automobile crash, there are ways of controlling the intensity of stimuli as an adjunct to efficient memorizing.

One principle is to prevent trivial things from occupying too important a place. We waste too much time fretting because the room is too cold or too hot, because the toast is too crisp or not crisp enough, because a speaker's voice is too loud or too soft, because it is too cloudy or too sunny. If you take an inventory of the things which stand out in a day's experience, you will be amazed at the number of trivial ones which present themselves.

As a result of allowing trivial incidents to dominate, we buy from a salesman because he has a suave manner or because we like his tie or voice. We are so intrigued by these nonessentials that we fail to judge the article he is trying to sell us. One of the favorite tricks of salesmen is to make some detail so vivid that essential factors are ignored. For example, a salesman may show an article which is so foreign to the prospective customer's taste that he does not want it at all. By leading the customer to specify some particular thing about the article which he does not like, the salesman may divert his attention to the consideration of possible changes in some unimportant detail. If the customer's attention is fixed upon this one detail, after the desired change in the detail is made, he may forget that he hated the article and, in the end, purchase it.

On the positive side, many experiments in the psychological laboratory have demonstrated the value of vividness in memorizing. In presenting series of numerals to be memorized, Miss Calkins interspersed with regular two-digit numerals some three-digit numerals, making the latter smaller and in red ink instead of black. The three-digit numbers, though smaller and harder, were recalled twice as frequently because they were more vivid.

If such simple devices as size and color of lettering can make so much difference in memorizing digits, it should be relatively easy to make vivid any material we must learn. The trouble with most of us is that we merely drift along and take things as they come. If we have to learn something which is uninteresting, we begrudge the time required to learn it, and undertake the task with indifference. What we should do is to stop until we can find some fascination in the things we have to learn, and then the learning will be easy.

3. *Recitations shorten the learning time.* Attempts to recite the material as soon as possible after it is memorized are helpful. The most blundering repetition, even with promptings at many points, is much more effective than a perfect reading of the material with no attempt to recite. This fact has been demonstrated in the laboratory with all sorts of memory materials. The student can use this principle in a class recitation by thinking the answers to the questions asked of his classmates. If he knows the answers, he is getting a helpful review; if he does not know the answers, the recitation of the student who has been called upon will serve as a prompter.

The adult student should not need class recitations; he should be able to devise ways of his own to test his memory. The method he devises will depend upon the material he is memorizing. We shall indicate a few sample methods.

If the task is to learn poetry, the lines of a play, or some similar material, the body of the page may be covered with a card when repetition is attempted. If a block occurs, the learner can prompt himself by this device without exposing more than one line at a time.

Vocabularies, definitions, formulae, rules, and similar material can be more easily learned if the stimulus words and their equivalents are put down in parallel columns; then the equivalents can be covered with a card and exposed only as needed.

Much of the learning of the advanced student requires the memorization of the important facts in what he has read. A device for facilitating this type of memorizing is as follows: After reading each paragraph or section, look away from the book and repeat the gist of what has been read. If you cannot summarize the material in a few short sentences, you do not understand it and you had better read it again. When you can summarize it, write on a sheet of note paper a key word or sentence which will help you to recall the principal points in the paragraph. You will then have a topical outline of the lesson when you have finished reading it. Study the outline to make it logical, and then use it as a basis for asking yourself questions. For example, on reading this text, you might have the word *recitations* in your outline. Can you give the gist of what you have been told about recitations helping your memorizing processes? If you cannot, glance through the text again and prompt yourself wherever necessary. In this manner you can use recitations and promptings to help you learn material which does not require rote memory.

Valuable as the device just mentioned may be, it tends to violate another principle in efficient learning. It has been found through repeated experiments that one can retain about the same percentage of what he has read whether he reads rapidly or whether he reads slowly. Taking into consideration the gain in time, rapid reading becomes much more efficient than slow reading. Furthermore, most persons can increase their rate of reading from one half to twice their present rate. Thus the advantage of rapid reading becomes even more apparent.

It would, therefore, probably be most efficient to read assignments once as rapidly as possible, and then, by way of review, make a topical outline of what was read. This may take either the form of silent recall or a written outline or both.

4. *Mnemonic devices aid memory.* Certain mnemonic devices have been highly advertised as methods of learning and of remembering facts and faces. Many men have paid large sums for courses in memory training. The basis for most of such courses is an elaborate scheme or outline of numbers or letters which the student must commit. Anything to be re-

membered is then fitted into this committed outline. Such a plan usually works. The only serious fault to be found with it is that generally more time and effort are required to commit the scheme than would have been required to commit directly the material to be learned. Furthermore, it takes a very ingenious person to fit much of the material to be learned into the schematic outline.

A better method of memorizing is to make a careful preliminary organization of the material. Then each part should be committed by making it as meaningful as possible. This is another way of saying that just as many associations as possible should be formed between the material to be learned and what is already known. Finally, these relations must be strengthened by emphasis and repetition. To refer to an example already given, if you want to learn the names of a group of men, pay particular attention to each name as you are being introduced. Repeat each man's name as often as possible while talking with him. Get as many facts about the man — his looks, his occupation, his home, his peculiarities — as possible. After you have left the group, try to recall these facts about each man along with his name. If this method is used regularly, almost anyone can soon become fairly efficient in learning people's names.

Suppose you wish to develop a device for remembering the outline of this section of the text. A possible scheme might be as follows:

Specific rules for memorizing.

1. Memorize with a specific purpose.
    a. Learning for immediate recall.
    b. Learning for limited recall.
    c. Memorizing for permanent use.
2. Vivid impressions last longer.
3. Recitations shorten the learning time.
4. Mnemonic devices aid memory.

5. Learn as a whole rather than in parts.
6. Rhythm or motor responses help memory.

Key words for each topic are: *purpose, immediate, limited, permanent, vivid, recitations, mnemonic, whole, rhythm.* Because these words are relatively unrelated they are hard to recall. How can they be brought into one mnemonic scheme? By a little juggling the first four can be changed to: *specific-purpose, limited, immediate,* and *permanent.* The first letters of these four spell SLIP. By changing *vividness* to *interest, whole* to *entire,* and *mnemonic* to *devices* and by changing the order of the five words, we get: *recitations, interest, devices, entire,* and *rhythm.* The first letters of these words spell RIDER. If the student can remember the two words *slip, rider,* as well as what each letter stands for, he has a key to the outline of this section.

The student will have to decide for himself whether such a scheme pays. The author once memorized the outline of an entire book in a similar fashion and passed an excellent examination upon it. To-day he remembers not a single thing that was in the book, but he fulfilled the purpose of the moment, which was to pass a good examination.

Another disadvantage arising from the use of these artificial aids to memory is that one may forget the key words. Such was the predicament of the character in the *Arabian Nights* who had only to remember the key words *open sesame,* but at the crucial moment he could think only of *open corn* or *open barley.* Suppose you cannot think of the words *slip rider* when you come to reproduce the contents of this section! Something similar, such as *slide runner,* will not help much. And certainly, ten years later, when you want to use your memory effectively, you will scarcely think of *slip rider* and by this means recall effective memorizing devices.

5. *Learn as a whole rather than in parts.* A long assignment of rote material is more easily memorized if it is either studied as a whole or divided into large sections which are memorized separately. An experiment in memorizing a poem of 240 lines indicated that such material was retained better when it was studied as a whole. Material without continuity of interest and meaning such as there is in a poem may not be so efficiently learned by the whole method. A good rule seems to be to learn the material in as large blocks as is possible. By this method one gains a perspective and a continuity of associations that cannot be obtained if the material is divided into bits. One who learns a poem a stanza at a time usually has great difficulty in joining the stanzas. This difficulty does not arise if the poem is learned as a unit.

Students who have used the method of learning by wholes in studying very complicated subjects report that it adds interest and continuity to the subject. For example, a student in psychology might profit by reading the textbook through at the beginning of the course. Each assignment in the course would then fit into a general background and be easier to grasp. If such a method is employed, many points will be hazy after the first reading, but they will become clear more quickly than they would if studied first in a separate assignment.

6. *Rhythm or motor responses help memory.* Any child knows that he can learn a poem more quickly if he emphasizes the meter. We have already seen how dividing digits into groups will increase the immediate memory span. This is virtually superimposing a rhythm on a series of otherwise unrelated elements. Even the poetry of a language foreign to us can be learned if we scan it. This is the same general principle that was mentioned under immediate recall. Rhythm helps in immediate recall and it also aids in delayed memory.

XXXIX. Retention

A person may improve his methods of memorizing in the ways described in the last section, but the ability of the nervous system to retain impressions depends upon physiological factors which are beyond his direct control. Retentivity is probably centered in the synapse. It is influenced by such factors as age, fatigue, poisons, drugs, and the like. The loss of memory follows a rather characteristic curve, called the *curve of forgetting,* and is the result of the combined operation of the laws of primacy, recency, frequency, vividness, and effect.

Retention Centered in the Synapse. Retention depends upon the persistence of modifications that have resulted from the experiences of the individual. The theory which maintains that these modifications are centered at the synapse has the following facts to support it: First, experiments have demonstrated that as a result of use, there is no apparent permanent change in any other part of the neurone. Second, the nervous impulse travels over a synapse in one direction only, as we have already mentioned in the discussion of the functioning of the nervous system. Third, there is evidence that resistance to the nervous impulse occurs at the synapse. Fourth, there is no evidence to show fatigue within the body of the neurone.

The condition of lowered resistance at the synapse may persist because the neural pattern involved is repeated frequently. Retention is effective under these conditions, and recall is not difficult. When, through disuse or for some other cause, the resistance at the synapses is increased, forgetting occurs. Impressions fade and ultimately disappear when the modifications made by learning are reënforced by neural patterns involved in everyday adjustments. Subsequent learning may also play a rôle in the process of forgetting.

Retention and Adjustment. A little child, whose nervous system is easily modified, learns very quickly to get along in his world. But as development and growth advance, the continuous need for further learning necessitates, if the new learning is to be effective, the forgetting of much that has already been learned. The child becomes more discriminating, his behavior is more selective, his methods of learning are more efficient. Furthermore, the passage of time has brought a significant increase in experience. A background, or fundamental pattern of habits, has been developed. Out of the mass of sensory impressions and motor reactions which the child has received and made, some have become an integral part of his adjustments to life. Speech habits are an illustration of this sort of thing.

One of the most striking characteristics of memory is the way in which it is organized. Every new experience is related to earlier experiences in such a way as to give one the impression that his memories constitute a continuum which becomes progressively enlarged and enriched as learning proceeds, yet maintaining at all times its essential unity. Life is not so much a matter of the addition of new elements, like adding new links to a chain, as it is a differentiation among the elements already possessed. Something new becomes significant as it is related to what we already know. We recognize objects in terms of the part they have played in our earlier experience.

Incidental Memory. Much that we learn is acquired incidentally; that is, some things have become ingrained in our memories, not because we have deliberately learned them, but because we have encountered them so frequently in our daily lives that they have unconsciously been impressed upon us. Most of the experiences which we make use of in normal adjustments are gained in this natural way.

Some of the things learned through incidental memory may be of great value at a later time, but others are useless. If you are hunting for something and suddenly recall that you saw it in a closet when you were on a totally different errand a few days ago, you may save yourself much time. However, efficient use of memory precludes dependence upon such incidental factors. Memorizing is largely substituting for incidental memories those which we hope will be useful to us. In short, one who memorizes with a purpose, as pointed out in the preceding section, will probably develop into a more efficient individual, even though he may not have as much retentivity, than another who depends upon his native capacity to retain any chance incidental memories.

The fact that we usually learn what we set out to learn and ignore irrelevancies is illustrated by this story, cited by Woodworth:

> There is a famous incident that occurred in a Swiss psychological laboratory, when a foreign student was supposed to be memorizing a list of nonsense syllables. After the list had been passed before him many times without his giving the expected signal that he was ready to recite, the experimenter remarked that he seemed to be having trouble in memorizing the syllables. "Oh! I didn't understand that I was to learn them," he said; and it was found that, in fact, he had made almost no progress toward learning the list. He had been observing the separate syllables, with no effort to connect them into a series.[1]

Obviously, we do not retain all that occurs. During each day we receive many different impressions which are lost because they have no part in the organization of our adjustments. As we grow older, incidental memories become less and less important to us.

Physiological Factors in Retentivity. There is some anecdotal evidence to show that in extreme exhaustion fatigue will adversely affect retention. In minor degrees physical fatigue does not seem to have a very marked effect. Fatigue and poisons conceivably have some effect upon neural connections,

[1] Woodworth, R. S., *Psychology*, p. 346. Holt, 1921.

but not nearly to the extent that many persons would have us believe.

Ill effects from memorizing itself seem to be very slight. One of the authors[1] performed an experiment in which subjects, for hours at a time, memorized the English equivalents for German words. There was no loss in retention due to fatigue. There was some loss in incidental memories. It is quite possible that, if the work is prolonged, there may be ill effects arising from distaste or other emotional reactions which will influence retention.

Drugs have been shown to have an effect on memory — mostly deleterious. Students have tried to find pharmacological means of improving retentivity, but about the only effective measure they can adopt is to take some stimulant which improves the general body tone.

Retentivity certainly changes with age. There seems to be an increase in the span of immediate memory from early childhood up to adult life. After maturity is reached, the memory span remains stationary until late life, when it decreases. One of the first signs of senile deterioration is the loss of retentivity. This change takes on a characteristic form. The person can usually retain very well impressions made early in his life, but he cannot retain recent experiences. In other words, memories formed early in life have left a permanent impress, but recent experiences can no longer permanently modify his nervous system. For example, such a person will tell you in great detail an incident of his boyhood, forgetting that he told you the same story yesterday.

Factors Which Influence Retention. We have said that what is retained depends upon a large number of factors. It may be well, by way of summary, to list the most important of these. They have already been enumerated in the preced-

[1] Morgan, John J. B., "The Effect of Fatigue on Retention," *Journal of Experimental Psychology,* Vol. III, 1920, pp. 319–333.

ing chapter under the laws of learning. They are: (1) use, (2) disuse, (3) effect, (4) primacy, (5) recency, and (6) vividness. It is upon the basis of these laws that material is learned.

The nature of the material also has an influence on retention. For reasons already explained, nonsense material is most rapidly forgotten; meaningful material is retained longest. Material largely motor in character is retained longer than any other type of material. A person who has learned to skate in childhood will require little practice as an adult. The writer once got on a bicycle after a period of at least five years during which he had not ridden. For the first few feet he experienced a peculiar feeling from moving through space in this manner, but there was no appreciable loss in the ability to ride. These illustrations tend to bear out the results of experiments of a similar kind in the field of ball-tossing and typewriting.

Can Memory Be Improved? Experimental evidence points to the conclusion that retentivity cannot be improved. The individual is born with a certain amount and a certain quality of neural tissue. Although he may exercise his muscles and make them grow larger and stronger, his neural tissue will not respond to similar treatment. The characteristics of our nervous system are what they are. No amount of effort or wishing will make them different.

Only one thing can be done, and it is of the greatest importance: the ability that one possesses may be used to its utmost capacity. To quote William James:

> The secret of a good memory is thus the secret of forming diverse and multiple associations with every fact that we wish to retain. But this forming of associations with a fact, what is it but thinking about the fact as much as possible and in as many ways as possible? Briefly then, of men with the same outward experiences and the same amount of native tenacity, the one who *thinks*

over his experiences most, and weaves them into systematic relations with each other, will be the one with the best memory.[1]

XL. Recall

Memories are of value only if they function at the proper time. The problem of recall is to revive the most pertinent memories and to inhibit irrelevant ones.

The Process of Recall. We often hear persons complaining that they cannot recall a thing. A study of the laws of memory will not enable us to recall everything we wish, but it will enable us to approach the problem in a more rational manner than by merely complaining.

The most serious difficulty in recall comes from the fact that the material was never properly learned. If, when you meet a person, you are more concerned with the pretty speech you are trying to make than with his name, how do you expect to recall his name when you see him again? The sight of the person is more likely to recall your pretty speech than his name. If you browse through a textbook, dreaming about your best girl, when you come to answer an examination question, you are more likely to recall visions of hair and eyes than material relevant to the examination. In short, the first step in the process of recall is adequate learning.

The second factor is a stimulus adequate to revive the memory. When two things are intimately related in our experience, the very presence of one member is often sufficient to bring up the other. For example, the sight of a dog immediately brings up the word *dog*. The sight of a good friend inevitably brings up his name. In less intimate connections the principle is exactly the same. The only difference is that the association is not so close and the same stimulus may be related to a number of different experiences with the result

[1] James, Wm., *Principles of Psychology,* Vol. I, p. 662. Holt, 1890.

that the particular thing remembered depends upon auxiliary factors. For example, *smoke* may be a stimulus which makes us think of tobacco, a disastrous fire, or perdition. But we do not think of any of these ideas unless a stimulus is present.

Consequently, we can make two approaches to the study of recall. In the one case we can take the memories which come to us and attempt to trace the present stimuli which gave rise to them. Such a study will indicate to us which types of connection dominated our past experience. Or we can give ourselves certain stimuli and note what memories or associations they call forth.

An understanding of the process of recall gives us a means for controlling it. For example, if you cannot remember the name of a certain city, recall when you were there last, how many previous times you have been there, the way in which you arrived there, who was with you, whom you met there, and as many other details connected with the city as possible. By the use of these various associations, you are more likely to recall the name than by any one of them alone.

Spontaneous Recall. There are two kinds of recall: spontaneous and deliberate. Belonging to spontaneous recall are all of those activities intimately related to bodily adjustment that have become an integral part of the behavior of the individual. Bodily movements, such as walking and other highly habituated acts, involve a sequence of reactions, one following immediately upon the other. Little or no attention is paid to the activity as it is carried on, yet each phase of movement involves the immediately preceding phase as its stimulus. This is habit on its most mechanical level. We see the same kind of recall in the action of a skilled athlete. What has happened is that certain factors in the stimulus have become linked with phases of the response in such a way that action occurs spontaneously and without attentive direction.

Another example of spontaneous recall, on a higher level, occurs under such conditions as reverie. Here the past is seen in the mind's eye, one experience succeeding the other, each in its time and place. The complete series of implicit reactions involved constitutes a sequence as in the first case. One reaction is both the response to the preceding reaction and the stimulus for the revival of the following one. In reverie and daydreaming, the character of the recalled experiences will depend, to a great degree, upon the particular set of the individual at the time. For instance, after a good meal, in happy and congenial surroundings, a man stretches out in a nice comfortable chair. He relaxes, as he enjoys his after-dinner cigar. The smoke drifting lazily toward the ceiling takes on different patterns; it becomes a screen for his memories. Early boyhood experiences, childhood ambitions, and other memories blend with more recent things. One picture fades as another takes its place.

Deliberate Recall. The fact that we are not always completely habituated to our environment makes deliberate recall possible. Sometimes situations arise which create a problem. There is a deliberate and conscious effort to determine what the situation involves and what we must do about it. Here we call on our past experiences. We attend to the situation, we make an effort to adjust, we recall our past to aid us at the moment. In such a situation we respond selectively. Memory is utilized in a specific way. We recall significant facts, not haphazardly, but with a definite purpose. Previous experiences are seen in the light of present needs. Here, the way in which our memory is organized plays an important rôle. In a sense our entire past becomes present. From it, we select those experiences which have particular significance for the problem at hand. The difference between this type of recall and reverie is that the motive or set is specific and definite. There is a problem confronting us and our recall is an attempt to get material by means of which we may make an adjustment to the situation.

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CHAPTER IX

THINKING

XLI. Discriminating and Generalizing

Fine discriminations are usually essential for adjustment to a complex situation. Blunders can usually be traced to failure to take note of some distinction which, on the surface, may appear to be trivial but which is actually the key to the problem. Equally important is the ability to discern in succeeding situations general elements, as well as the ability to unite these in the form of general principles by means of which new problems can be solved.

Maladjustment, the Stimulus to Discrimination. In our study of perception, it will be recalled, we found that a person will use a single item or a few items of a situation as a cue and respond as he did on a former occasion when the cue was present. The cue is a stimulus to a response which was successful on a previous occasion when the cue was merely a part of the total situation. The same reaction may lead to desirable results or may eventuate in a blunder. If you bow courteously to a girl in a coonskin coat which you have seen before only to discover that, while the coat appears to be the same, the girl in it is not, you learn to look thereafter at the girl as well as the coat before you speak.

The little child, upon being told that a certain book he sees is a Bible, will call all books Bibles. He has to learn to distinguish different kinds of books. A soft, hairy thing is called a kitty and henceforth, until he gets more experience, every furry thing — his mother's coat and the tiger-skin rug — are all kitties. Who has not heard a child call a canoe a ship, an apartment building a cottage, a rivulet a river, and a lion a kitten? Mental maturity is largely a process of building finer and finer distinctions. Words are only means of expressing these distinctions, but they are very effective means, and, for this reason, a man's vocabulary is a very good index of his intellectual maturity.

It is relatively easy to distinguish small differences in objective things and events, but it is often very difficult to use discrimination in our dealings with persons. Since adjustment to others is such an essential part of the organization of life, a knowledge of psychology should be of great value. A novice in psychology is likely to make a mistake similar to the blunder made by the young child; namely, he fails to discriminate. He learns that there are some general principles which govern human conduct, and then assumes that all persons are alike in their personalities. The expert learns that, while there are general principles, they appear in a different combination in each person. Such ability to discriminate enables the expert to make intelligent adjustments to a great variety of persons.

Relevant and Irrelevant Distinctions. The wise man makes distinctions which give him adequate control of the situations in which he finds himself. The essential point is not merely to make discriminations, but to make relevant ones.

A father once bought his boy a stick of candy. The boy was dissatisfied and told his father he wanted two pieces; whereupon the parent said, "All right, I will make two pieces for you," and broke the stick into two pieces. The boy's face brightened and he was satisfied. This illustrates a childish lack of distinction between amount and number, but many adults are deceived by similar tricks. A company will split its stock and give two shares for each one previously held. The holders think they have gained something of value. They have nothing more — only the old stock broken into two pieces.

Of course, it is possible that through market manipulation or improvement of manufacturing conditions added values may result, but it is just as likely that the whole procedure is another case of " watering " the stock.

A salesman was trying to sell a refrigerator to the owner of a restaurant. The owner said he could not make the payments of fifty dollars a month. The salesman replied that he could arrange that: the owner could pay sixty-five dollars more on the first payment, sixty-five extra at the end of the first year, and thereby reduce his monthly payments to thirty-five dollars a month. The owner was satisfied with this " concession " because his attention was diverted to the irrelevant detail of the amount paid per month instead of being fixed on the important consideration of the total amount paid during the year. A man who bought a lotion from a druggist complained that the druggist was charging as much for three ounces as was charged for four ounces in another store. The druggist agreed to give four ounces for that price. He poured the lotion into a four-ounce bottle, added an ounce of water, changed the label from an 8 per cent to a 6 per cent solution, and satisfied his customer. Life is full of instances where adults are duped because in the process of distinguishing irrelevant details they fail to note the significant thing.

Experimental Analysis of Differing Factors. If satisfactory adjustment requires that a person distinguish relevant from irrelevant differences, by what means can he discover which are significant distinctions? Usually one hears two answers to this question. One is that the person can experiment, or make various trial-and-error reactions, until he learns the significance of the differences he observes. The other is that the person can reason, and thus arrive at some evaluation. The difference between these two processes has usually been advanced as the distinguishing mark between man and animals. For example, James said:

Cats have been known to open doors by pulling latches, and so forth. But no cat, if the latch got out of order, could open the door again, unless some new accident of random fumbling taught her to associate some new total movement with the total phenomenon of the closed door. A reasoning man, however, would open the door by first analyzing the hindrance. He would ascertain what particular feature of the door was wrong. The lever, for example, does not raise the latch sufficiently from its slot — case of insufficient elevation — raise the door bodily on hinges! Or door sticks at top by friction against lintel — press it bodily down! Now it is obvious that a child or an idiot might without this reasoning learn the rule for opening that particular door. I remember a clock which the maid servant had discovered would not go unless it was supported so as to tilt slightly forwards. She had stumbled on this method after many weeks of groping. The reason of the stoppage was the friction of the pendulum-bob against the back of the clock-case, a reason which an educated man would have analyzed in five minutes.[1]

In any case the occurrence of a new hindrance — an unusual difficulty — leads to *experimental reactions* in an endeavor to discover the significant difference between this situation and others which we have solved. An animal or a person of low intelligence does a great amount of fumbling and often discovers the solution to the problem by mere chance. Even then, the animal or the idiot may not see the significance of the actions that brought about the solution.

The intelligent man *varies* his experimental procedure. He searches for differences between the present problem and previous problems of a similar nature. He then relates his experiments to these differences. Furthermore, he takes particular note of the various things he tries, and, when he finds that a specific movement does not bring success, he alters his attack. The unintelligent person and the animal will repeat the same thing over and over in identical fashion.

[1] James, Wm., *Principles of Psychology*, Vol. II, p. 339. Holt, 1890.

The intelligent person also does a third thing which we call *reasoning*. Before making any overt reaction, he revives memories of similar past experiences and compares them with the present situation. He speculates as to what may happen if he does this, that, or the other thing; and finally, after deciding in the light of previous experience what will happen if he does a specific thing, he tries it out. In short, he tests his solution in his mind before he puts it into action.

We shall go into a more detailed analysis of the reasoning process shortly. We wish merely to indicate at this time that the nature of reasoning is essentially the same as that of actual experiment. In reasoning some of the experimenting is performed by internal processes rather than by overt movements, the overt reaction being reserved for a final check.

Insight as a Result of Experiment. There is a difference between a reasoned experiment and tinkering. The object of a true experiment is to make finer distinctions, to make the statement of our problem more and more specific until it is finally reduced to some simple alternative which can be tested under controlled conditions. Take the case of the sticking door described by James. We have gone through doors that did not stick. Since this door sticks, it must be different from other doors we have known; so we try to discover the way in which it differs. Perhaps this door is green and we have never seen a green door before. In all our previous experience have we ever found color related to sticking? No. Then we must discard that theory. But paint — we have known paint to cause sticking. Perhaps that is the cause of the difficulty. When we push the upper part of the door, we notice that it moves back from the door jamb. It is not sticking at the top. We try the bottom and find that it moves back there also. But when we try at the middle, we find that it does not move away. We have found the point of the difficulty. Now what is its cause? Is it the paint at the middle of the door? We observe that other things than paint might cause it to stick. The knob turns, the catch moves. But does it move far enough? Now it could be two things, the paint or the catch. So our problem is resolved into a question as to which it is. When we turn the knob, it does not move so far as other knobs in our experience; so we favor the hypothesis that the catch is causing the door to stick. We test our hypothesis by turning the knob the other way. If the door opens, we conclude that when we turn the knob in one direction the catch is not released. We have solved our problem.

In short, if we do not perceive a difference between the present situation and a previous one, we respond to the present situation in the manner which brought us success before. If such a reaction brings failure, we investigate further in order to discover differences between this and similar previous experiences. Having observed a difference, we experiment to determine whether the difference is a significant one. If we solve our problem in this manner, we have gained insight into the significant difference between the two situations. There may be a number of other differences, but we have learned that they are not of primary importance for the solution of our problem.

Generalization. By selecting recurring features in successive situations man is able to generalize. If I go back over my past, I may recall that in 1920 it snowed in the winter. In 1921, 1922, 1923, and so on until this year, it has snowed every winter. From these facts I can generalize and say that, as far as I can recall, it has always snowed in the winter. Generalization is thus nothing more than isolating the common element in a series of experiences. It is extremely valuable, because it gives us clues upon which we can base our reactions. From generalization we can proceed to various forms of thinking. But because such procedure has its dangers, one should understand clearly the significance of generalization in relation to expectation and prediction in order to avoid error in his thinking. Since it has snowed every single winter in my experience, am I justified in making the statement, "It always snows in winter," or "It will snow this winter"? The first is a statement of a principle and the latter is a prediction. Can I legitimately make predictions or deduce abstractions from generalizations?

Generalization and Prediction. Predictions made on the basis of a generalization derived from a very few experiences are unwarranted. Those based on a generalization that is derived from a large number of experiences may be valid, but even in this case the prediction is merely the expression of an expectation. The sun has risen without fail every day of my life. Others who lived before me report that it has never failed to rise. Hence, the expectation that the sun will rise to-morrow may be justified. But even such a well-substantiated generalization does not prove that the sun will rise to-morrow. It simply confirms my expectation that it will.

The dangers that lie in prediction based upon a generalization derived from a single experience may be illustrated by an extreme example. A young man who has been jilted by a girl makes the generalization that all girls are untrustworthy. It would be just as silly to generalize from a single tossing of a coin that heads would invariably turn up whenever the coin was tossed. Repeated tossings of the coin show that approximately half of the time heads turn up and half the time tails. Thus, on the basis of a great many tossings we have a reasonable expectation that in the long run we shall get fifty per cent of each.

Great numbers of such expectations govern our lives. They provide short cuts for adjusting our living, and are very valuable so long as we remember that they are only expectations, with varying degrees of possibility for eventuation. Generalization and expectation play an important part in what we ordinarily call thinking.

Generalization and Abstract Principles. If we can discover some common element in successive experiences, our expectation of what will happen becomes more certain than the probability that the future will repeat the past. If we can see such a thread of relationship, we usually attempt to form some statement that will express it; that is, we make an abstraction.

This procedure is illustrated by a test used in the Stanford Revision of the Binet-Simon Scale. It runs something like this: "If you fold a sheet of paper once and tear a piece from the folded edge, there will be one hole in the paper when you open it. Fold it twice and tear a piece from the folded edge, and there will be two holes in the sheet when you open it. Fold it three times, and there will be four holes; four times and there will be eight holes; five times and there will be sixteen holes; six times and there will be thirty-two holes. If you fold it again, how many holes will there be?" From this series of tearings the intelligent man can derive a principle which might be stated as follows: Each folding doubles the number of holes the tearing will make. By applying this principle, I can predict that if I fold the sheet of paper ten times and tear a piece from the folded edge, there will be 512 holes in the sheet when I open it. I have never seen it demonstrated, but I am absolutely sure that, were it tried, the results would be as predicted.

It is in this respect that the intelligent man surpasses his less intelligent fellows. He not only generalizes and predicts on the basis of these generalizations, but he also derives principles which state abstractly the relationship between series of events. By means of these principles he is able to predict with certainty what will happen in hypothetical situations where these principles apply.

XLII. Imagination

We often save ourselves costly errors by adjusting to hypothetical situations. If we try various reactions in our imaginings, we can put into effect only the one that promises success. Properly used, imagination results finally in a reaction to our environment, as happens when imaginations become ambitions. If it is used as a substitute for adjusting to our environment, it may end in useless daydreams.

Memory and Imagination. The central neural processes may run their course without being accompanied by actual motor response. In the same way we may substitute inner experience for actual sensory experience. In imagination we *think* how we should react to a *thought-of* situation. Obviously the activities of imagination are based on experiences we have actually had. Sometimes they are literal reproductions of past experiences, as when we imagine ourselves back at the old swimming hole, with all its familiar details, swimming in exactly the same way as we did when we were boys. Often the elements are rearranged into new forms, so that we imagine scenes which are quite different from those actually experienced. In these, even when they become most grotesque, the components are based on past experience. Consequently, memory plays an important part in imaginary processes.

When the imagination is a true representation of what has happened, it is called *reproductive imagination* or *memory*. It is literally a living-over of the past.

When traces of memory are patterned into some new form we have what is called *creative* or *productive imagination.* Productive imagination is the basic activity in all creative work. Science and invention, art and philosophy depend upon it. Any new invention or scientific hypothesis is the result of the process of fashioning the past, and all that it involves, into a new pattern. It is like the old, yet it is new. Every part is comparable to something already experienced; yet the total pattern is a new product. The composer writes his imagined music; the architect builds his dream into brick and stone and brass; the philosopher weaves his intricate web of thought. Here creative imagination functions and creative energy gives it objective reality.

Imagination and Effective Adjustment. Imagination, as a productive function, sometimes reduces to pure fancy. Many persons build for themselves a dream world which rivals the world of reality as far as they are concerned. Fanciful construction on the part of children is a very natural thing; a little bit of such activity in adults is not undesirable.

After one has done the best he can to adjust to an actual situation, he may go over in his mind what has occurred and, by means of internal manipulation of the situation, make hypothetical adjustments which he thinks would have been more effective than those he did make. If his actual adjustment was a very faulty one, he may have had some very uncomfortable feelings connected with the whole scene. In the imaginary reactions which he later makes, these undesirable elements are usually lacking. He makes a better adjustment, feels much happier about it, and may actually be elated over his hypothetical victory.

Such a procedure may lead to two types of habitual response. The person may get so much joy from his imagined victories and so much pain from his actual failures that he tends to minimize the importance of actual accomplishment and revel in his fancied prowess. In other words, he becomes a daydreamer. The temptation to such a procedure is very great, for it is easy to succeed in imagination but very difficult to succeed in reality, especially when the factors in the real situation do not lend themselves to as easy manipulation as do the imaginary factors. When one finds himself spending too much time daydreaming, he can assume that life has been unsatisfactory to him and that he is adopting this means as a substitute for actually adjusting to reality.

To overcome this condition the individual should not endeavor to suppress his imagination. What he should do is to choose the second of the two types of response that are possible; that is, he should use his imaginary success as a guide in making future adjustments more successful. In short, his daydreaming becomes transformed into an ambition. One cannot be ambitious without picturing a future which is much more desirable than the present. This imaginary process presupposes dissatisfaction with the present; but instead of stopping with the present or with vain imaginings of what the future may be, the ambitious person tries to relate his present situation to the imagined future and work toward it by adjustment to the real facts of life. For example, a person who makes a very poor performance when he tries to play a violin may get much satisfaction from imagining he is a Kreisler, but if he is so satisfied with this picture that he ceases to practice his music, he is doing himself an injury. If, on the other hand, he uses the vision of himself as a Kreisler as an incentive to keep practicing, his imagination serves a very useful end.

An active imagination is essential to effective adjustment. Under proper control, it makes possible a more satisfying life. The ability to anticipate possibilities by correctly constructing them out of relationships found in previous experiences makes a person better equipped to cope with the problems of adjustment and prepares him to meet new demands when they arise.

Before any new invention becomes tangible, it is imagined in the mind of man. Before any audience is thrilled by great music, that blending of harmonies was conceived in the mind of a genius. Every great business, every great social advance, was imagined and reasoned into ideal form long before the first effective efforts toward tangibility were made. No matter how satisfactory a situation, man possesses the ability to imagine something better. No problem is so complex that it does not challenge his interest and fire his imagination.

Imagination and Thinking. Imaginary processes are of vital importance in thinking. A person may adjust without any imaginary processes. He can, when confronted with a problem, try successive reactions until he meets with a modicum of success. But in thinking, he first tries various solutions in his imaginings, only putting to actual test those which seem to be feasible. The importance of this will be apparent when we have gone into a more detailed analysis of the thinking process.

XLIII. Thinking as Adjustment

Thinking is hypothetical adjustment. It has developed to a very high degree in man because, in addition to being endowed with a very complicated nervous structure, man has devised speech symbols to help him in his thinking. How these coöperate in the thinking process will be discussed in this section.

The Importance of Thinking in Adjustment. The importance of a man's ability to learn new ways of meeting environmental needs cannot be overestimated. The capacity to acquire an adequate understanding of new relationships is a mark of intelligence of a high degree. The ability to get beyond the necessity of testing possible solutions by overt trial and error makes for a more adequate survival in the struggle for existence. A rat cornered turns and fights for its life. It risks its life with every overt attempt to meet the situation. A monkey may make one random movement after another as it seeks to grasp a banana beyond reach. A man confronted with a problem sits down and thinks. The selection of a possible solution comes only after he has in imagination tried out many ways of responding.

Conditions under Which Thinking Takes Place. Most of our waking life requires some form of adjustment more or less under our control. In the main, we are faced with few real problematical situations. The daily round of things to do becomes fairly routine. The individual recognizes the environmental demands and reacts to them by organizations of habits approximately adequate. He perceives relationships that have been previously established, remembers familiar names and faces, and makes routine adjustments. All this involves thinking on what has been called the perceptual level.

But the environment is not a fixed and stable thing. The situations which demand responses from the individual are sometimes sufficiently unfamiliar to require new adjustments. Then the individual has to repattern his habits, establish new coördinations, and become aware of new relationships before he achieves a satisfactory adjustment. This type of adjustment involves imagination and reasoning. By his power to think man gains his tremendous adaptability. He controls the natural forces which are often too great for lesser creatures and, going a step farther, he develops ways and means of improving on nature.

Mechanisms Used in Thinking. Thus far we have given a very general description of thinking in terms of the part it plays in the life history of the individual. We now turn to an analysis of the process. First, we shall attempt to describe the physiological processes which occur when a man thinks. Later, we shall try to describe or interpret thinking in terms of the verbal organization it takes in its more formal aspects.

Traditional psychology emphasized the fact that the cerebral cortex was the physical mechanism upon which thinking depended, and without doubt, this highly complex structure is an essential factor in thought. However, as has been pointed out in an earlier chapter, the organism does not normally function in parts, but as a whole, and we may reasonably expect that this tendency is maintained in the act of thinking.

One of the most prominent reactions involved in thought is speech. Observe yourself as you think. Quite likely you will notice a tendency to say subvocally the words which are used to symbolize the act or the situation. Most observers agree that internal speech is of tremendous importance in thinking. Tightening of the skeletal muscles is also likely to occur when an individual is attempting to solve a problem. Professor Bills of the University of Chicago made a study of this phenomenon and found that when the body is relaxed, the mind does not do its best thinking. Some investigators have observed that visceral reactions are also involved. Respiration seems to increase in rate and circulatory changes occur.

It is evident that the whole organism is involved in thinking. The cerebral cortex, with its millions of possible neural connections, furnishes an adequate correlating center; the striped and smooth muscles each play a part in the total reaction pattern. Now the question may be raised, "What mechanism plays the dominant rôle?" Watson and others hold that the laryngeal muscles involved in speech play this important part. This position appears reasonable when we consider that verbalized reactions are by far the most useful in thought. Words may involve whole patterns of implicit reactions. An economy and a refinement of adjustment should result from this focalization of the reaction pattern.

That other effector mechanisms have a part is equally evident. Some persons say that they can think better on their feet, meaning that a certain set of the body is necessary for satisfactory thinking. Other persons appear to have become habituated to different postural adjustments, such as waving the hands and arms.

In conclusion, we may describe the physiology of the thought process in this manner: Confronted with a problematical situation, the individual adopts that type of attentive attitude best suited to a quick determination of what the situation demands.

Afferent impulses, peripherally aroused, produce implicit reactions. These reactions, in turn, become stimulating conditions for further implicit reactions. The cerebral cortex maintains the rôle of the central connecting and integrating mechanism. The skeletal and smooth muscles are involved in the reaction. Predominant in this continuum of activity is the action of the laryngeal muscles that furnish the mechanism for complicated verbalization. Old habits are aroused and repatterned. Partial arcs and residues of previous reactions develop into a new form of coördination. Over all this, the implicit activity of the larynx verbalizes the potential reactions as they are integrated into a new pattern. Implicit trial and error become symbolized in speech until one pattern of reaction becomes overt in behavior.

Language and Thought. In the foregoing paragraph, we have given the dominant rôle in thinking to the speech mechanism. It would be a mistake to limit thinking to this activity alone. It would be sheer dogmatism to maintain that without activity of the vocal cords thought is impossible. On the other hand, we must recognize that the ability to substitute words for acts is most useful in successful adaptation. The baby who has not yet learned to talk has to depend on the skill with which its parents can observe and interpret its behavior. The infant's early cries soon become differentiated. By the time it is six months old, it can make as many as sixty-four different sounds. At a later period still, some of these sounds, slightly elaborated, are used as substitutes for objects and acts. Spoken words become stimuli which produce specific actions on the part of the child. Recognition of words heard precedes the ability to speak them, but these two elements in the acquirement of speech habits by the child are closely related.

As the child acquires a vocabulary, another step in his development takes place. At first the use of the words is very primitive, but as the child's adjustments become more discriminating, his speech becomes more adequate. At first any animal may be called *dog,* but later animals are called by their correct names. The word *animal* becomes a *general concept,* while the word *dog* becomes a *specific concept* for a particular kind of animal. The *concept has its inception in the developing discriminatory capacity of the child as related to the habits of speech.* As soon as objects have meanings not explicitly present in the sensory data, the verbalized part of the reaction to the objects begins to function as a concept. Gradually the tendency toward generalization and abstraction becomes more explicit. A word may have specific or general significance. It may be used to symbolize a single reaction or a pattern of reactions. It may have individual or general reference.

During the life history of an individual, his perceptual life becomes progressively enriched by his constant adaptations. His world becomes more meaningful; so his thought becomes proportionately enriched. Instead of responding with a great many explicit reactions, he utters a word. He economizes time and energy. By making use of words, which have so much implicit significance, a person can convey to other individuals his solution of a common problem.

The Use of Concepts. The word *concept* as it has just been used refers to the name for a class of objects. If I am looking at a dog, I have a percept of a dog. If I think of this same dog when it is not present, my mental process is a memory. If, on the other hand, I am thinking of the class of objects called dogs, I am employing a concept. Concepts are general symbols which function in our solving of problems.

Man relates concepts to form a *judgment.* Judgments do not result in any new discovery of relationships existing between concepts, but merely in a verbalization, in explicit or implicit form, of associations previously experienced. For instance, a person may say, "This is a bright sunny day," or

" This rose is red," or " That paper is white." In each sentence the person has related certain sensory impressions to previously experienced ones. Old associations have become reenforced by the new expression of relationship. Most of our perceptual life is made up of activities of this nature. The essential factor of creative thought — namely, a problematical situation or a felt difficulty — is not present.

Sometimes a situation arises in which the thinker makes an assertion regarding the relationship of the several factors involved which depends upon the individual's awareness of possibilities not explicit in the stimuli. Such an assertion is called an *inference.* The making of inferences is a definite step in the reasoning process, as we shall see later. Illustrations of a judgment and an inference may make the difference between them a little clearer. If one says, on looking at a picture, " This picture is a miniature," he is making a statement based on the sensory data of size and composition, which are a part of the stimulating situation. This is a judgment. If the person says, " This picture is a very rare work of art," he is making an inference. He has related what he knows about painting and artistry to the perceptual relationships immediately established as reactions by the first response to the stimulus situation and has evolved therefrom a new concept which may or may not be true, but which is capable of being proved.

In every problematical situation, one has to establish the problem by means of judgment and formulate the basis for solution by inferences which are evaluated and tested.

Types of Thought. On the purely perceptual level, thinking has been further described as *reverie* and as *routine thinking.*

1. *Reverie.* Reverie, Dewey suggests, makes up the greater part of mental life. It is essentially the same as daydreaming. In reverie, as has been noted, one thought follows another in a more or less random fashion. Some stimulus serves as the

starting point and each succeeding implicit reaction acts as a stimulus to the next one. There is a general relaxed condition of the muscles, and sometimes a definitely pleasant affective tone to the associated thoughts. This type of thinking is essentially passive in character. Sometimes we are merely recalling past experiences; more often, we are imagining situations and reactions in which we see ourselves playing a more prominent rôle than is actually the case in life. The best that can be said for this type of thought is that it tends to keep past experience available for use when needed. The worst that may be said is that, carried to extremes, such thought leads the individual to become self-indulgent. The satisfaction gained from wishful daydreaming may make daydreaming more and more necessary to happiness. Imaginings may become a substitute for the more virile activity which results from a positive adjustment to the environment as it actually is. Fleeing from reality by this means is dangerous. The young fellow who, failing to answer the boss effectively, spends his day imagining clever retorts he might have made instead of drawing useful lessons from the actual experience is making life increasingly difficult for himself.

There are times when reverie becomes productive of something useful. A writer of advertising copy once told the author of his efforts to think of a slogan for a particular advertisement. Try as he might, nothing even partially satisfactory would come. Sometime afterward, as he was thinking about it in a most casual manner, a very effective slogan occurred to him. A similar instance is that of a man of large responsibility who, quietly musing over the day's work, was startled by the character of his reverie. He had imagined a type of office organization which, when it was later put into operation, saved his firm money and made a reputation for himself.

2. *Routine thinking.* Routine thinking is closely related to reverie, but it is slightly more active in character. In this type

of mental life, familiar, tangible objects make demands which are immediately recognized and met. For example, a man recalls the name of the person who steps up to his desk. He greets him, and asks about his recent trip. Again, he remembers that to-day certain reports have to be made ready, and calls for the necessary materials and a stenographer.

When the environment becomes so highly stabilized that the only type of adjustment required is that which is based on habits previously formed, which involves little reorganization of habit patterns, and which calls for no new modes of response, routine thinking reigns supreme. Persons continually in this kind of environment get into a rut. Living in a ready-made situation, they lose intellectual vigor and adaptability. New situations, instead of challenging them, make them angry or dissatisfied. Business policies, long since inadequate, are not changed because they involve adjustments out of the routine order of things. The *status quo* seems adequate because the only responses the individual makes are to stimuli to which he has become habituated.

Routine thinking may be described further in terms of the situation in which it is carried on. For instance, one may deliberately attempt to recall a specific order of events leading up to or following a particular experience. In this case, the line of thought is given direction by the end that is desired. It is productive only in the sense that it reproduces the earlier experience. The problem involves merely the correct reëstablishment of memories; it does not create a need for the discovery of new relationships. A person on the witness stand is often asked to relate what he did on a certain day. A stockbroker recalls the fluctuation in price of a certain stock over a period of weeks. A salesman, outlining his itinerary, recalls his previous trip. These are illustrations of routine thinking.

Again, we may include in this discussion a very common type of thinking found frequently in the classroom or in any situation in which direction is given to the behavior of individuals by some other person. A teacher may state a problem and then solve it for the class. The members of the group attempt to understand the significance of the procedure and the principles involved, as revealed by the directed inquiry of the teacher. A prospective buyer is in the same situation when a salesman delivers a planned sales talk in which every advantage of the product to be sold is discussed and evaluated.

The distinction between reverie and routine thinking is to be found in the character of the stimulating conditions and in the directional or purposeful nature of the reactions. In reverie, as we have found, each thought as it develops becomes an immediate stimulus for the subsequent thought. This is the reason that we sometimes think of reverie as being a subjectively determined process. There is no definite direction or order in the sequence of reveries except that direction which the pattern of the individual's past experience and his general affective attitude happen to give it. The person who is well fed and satisfied with life has a different type of reverie from the individual who is hungry or dissatisfied. One thinks pleasant things about the world and himself; the other very likely finds his thoughts tinged with bitterness and his reverie most unsatisfying. In routine thinking, however, the stimulating situation is more tangible, and the associated ideas are specific with reference to the needs of the situation.

XLIV. Reasoning

We have shown that thinking involves discrimination, generalizations, experimentation with close observation of the results, and the use of imaginary processes. All of these can be gathered into a specific technique called *reasoning*. The student will note that the outline of this technique is practically the same as that described in the first chapter as the scientific method.

Steps in the Reasoning Process. In his book *How We Think*,[1] John Dewey has outlined the steps in the reasoning process. These are listed as: (1) the problem or felt difficulty, (2) a statement of the problem, (3) the development of possible solutions, (4) the tentative acceptance of one solution, (5) its final acceptance or rejection on the basis of proof.

1. *The problem or felt difficulty.* From the point of view of relationship between the individual and his world, reasoning may be said to appear when some maladjustment is present. The degree of maladjustment may vary. It may be so slight that a hasty investigation of it and a minor shift in adaptive action will suffice to bring about a satisfactory adjustment. On the other hand, the maladjustment may be so great and the clues as to possible solutions so vague that a prolonged effort may be required. An illustration of the former type of maladjustment is the everyday conflict in deciding which tie or suit to wear. The scientific investigations of Pasteur or the monumental efforts of Darwin illustrate the second type of problem.

2. *The statement of the problem.* Language, with its symbolic forms by means of which the factors in the problem are related, occurs with the statement of the problem. The degree to which difficulty is experienced in stating the problem depends upon its complexity and novelty. In many instances there is an overlapping between the statement of the problem and the possible solution. Overlapping occurs most frequently when the maladjustment occurs often and has many aspects which are familiar. Usually the problem is stated in the form of a judgment or a series of judgments.

3. *The development of possible solutions.* After the general character of the problem has been stated or recognized, the individual proceeds to discover relationships between factors within the total situation. He makes use of his past ex-

[1] Dewey, John, *How We Think*, pp. 93–96. Heath, 1910.

perience. On the basis of previously acquired knowledge, he infers that certain possible causes and effects may be involved. These inferences are an important step in the reasoning process. They form the basis for proof of an adequate and satisfactory solution.

4. *The tentative acceptance of one solution.* Any solution must be a tentative one until it has been tested with reference to the facts of the situation. In order to proceed after all possible solutions have been inferred, one which seems most reasonable or likely is selected and tested. This procedure is the one followed by a doctor diagnosing and prescribing for an illness of uncertain origin. When a patient shows symptoms that are common to several maladies, he is treated for that disease which seems to be the causal factor commonly associated with a majority of the symptoms. This is a tentative diagnosis and treatment, and is maintained only if the subsequent history of the cases warrants it.

5. *The final acceptance or rejection of the solution on the basis of proof.* A solution is accepted or rejected as it meets the demands inherent in the problem. If the solution satisfies the various facts, enables the individual to make a satisfactory adjustment, or forms an adequate basis for prediction and control of similar maladjustments in the future, it may be accepted. If it does not fulfil these requirements, it is rejected and another solution is tentatively accepted and tested.

This constitutes the ideal or logical procedure in reasoning, but a person does not always follow it. Sometimes the problem and the solution may occur simultaneously. For example a sudden noise may immediately suggest its source — a punctured tire or perhaps an approaching thunderstorm. At other times, the problem and the solution may be widely separated, necessitating every step in the process before satisfaction is gained. For instance, a scientist raises the problem as to the birthplace of the human race. Years of research are necessary before even the possible solutions are available for testing, and then the assembling of data still remains as a major task before the proof of any hypothesis can be established. Other variations may occur. A possible solution may be tentatively accepted and data gathered which appear to be useful as proof; then a reëxamination of the problem itself may necessitate the abandonment of the entire process as previously carried on. Again, the problem itself may become vastly enlarged as research progresses or, on the other hand, it may be simplified so that it will be possible to predict the result without determining the intermediate factors.

In ordinary circumstances one rarely follows the formal steps which Dewey suggests. The scientist in his laboratory, who knows the difficulties involved in proving any problem, may feel the urgency of controlling his variables by rigid adherence to as formal a method as possible. But the average person, more often than not, jumps at conclusions.

Suppose you went into your room, which you had carefully straightened in the morning, and found it very much upset. Immediately you would say, " Some one has been here." That would be self-evident. The problem would be to determine why some one had been in your room. Was it a practical joke? Was robbery the motive? These possibilities you would test by inspection, searching for valuables you had left in the room, seeking some definite cue which would establish one possible solution as the most adequate one. Suppose your watch was missing; also your formal clothes. Perhaps some money as well. This would be enough proof for you. You would conclude, and probably believe, that a robber had been there.

Your judgments concerning the condition of the room would be based on the sensory data at hand. Your inference that some one had been there would be based on the fact that, as a rule, things cannot move themselves. This inference involves a third factor which, although not present, is essential to the problem. The inferences regarding motive were tested by examination of the situation. One inference seemed the most possible solution. It was tested by further investigation and accepted as true.

Methods for Securing Solutions. In the past, two methods have been employed in securing solutions to problems in which implicit reactions were involved. These processes are called *induction* and *deduction*. Induction may be defined as a method by means of which we proceed from particular facts to general principles or laws. Deduction is the method by means of which we proceed from general principles to specific and particular facts. According to the definitions, there seems to be a marked divergence in the procedure of these methods, but such is not the case. In almost any reasoning process both of them are involved. A classic example of deduction is the following syllogism:

All men are mortal
Socrates is a man
Therefore Socrates is mortal

An illustration of inductive reasoning is furnished by the way in which a fountain-pen manufacturer determined the price and character of his product. He sent workers into stores and colleges to ask people what sort of fountain pen they wanted. The price these persons were most willing to pay, and the size and the color of the barrel they preferred were items especially significant for his purposes. After these facts had been gathered, the manufacturer made a generalization as to what would be a popular fountain pen.

Modern scientific procedure claims the inductive method as essential to its development. Huxley defined the true scientist as one who scrutinized all the facts and followed where those facts led. The use of experimental techniques has fostered the inductive method. The solution of problems on the basis of an interpretation of related facts which have been secured under controlled conditions is the very essence of scientific method.

It would be a mistake, however, to consider that the deductive method plays no part in modern science. The experimenter has a problem before he begins his research. In order to begin an experiment he must make inferences which are to be tested. These inferences may be deductions from the general nature of the problem itself. It must also be remembered that the distinction between induction and deduction turns on the use we make of the suggestion or hypothesis. Given a suggestion, we may proceed to collect evidence that can be explained by means of the suggestion, or we may predict on the basis of the suggestion what facts we shall find.

Advantages of Reasoning. Let us summarize the most significant advantages which accrue from reasoning.

1. *Reasoning involves an economy of energy and time.* Testing alternatives mentally is much quicker and, in general, quite as satisfactory as testing them by overt behavior. The ability to imagine results from this or that move often saves time and energy.

Before introducing a costly change in policy, the good administrator can test the merits of the change by reasoning. The architectural engineer may determine by reasoning and imagination the effect of certain structural changes and bring about a saving of money and time in building.

2. *Reasoning facilitates survival.* An animal placed in a problematical situation finds a solution by overt trial and error. A man tests possibilities by implicit trial and error. The animal risks its life; the man reduces the possibilities of unfortunate consequences by selecting special tentative reactions, after he has tested many alternatives implicitly. Logical reasoning coupled with a disciplined imagination has saved man in many difficult situations.

3. *Reasoning brings to light new relationships which may have further value.* Reasoning is essentially a creative act. Its successful pursuit results in a conclusion which involves an element of novelty and newness. The extent of the novelty varies, depending largely upon the nature of the problem. By means of controlled imagination and active reasoning powers, astronomers have swung their telescopes to a certain area of the heavens and predicted that a new planet or a new star should be visible at a certain time. And so a new planet or star is discovered. By the same procedure Newton worked out the law governing the relationships existing between falling bodies. In a less spectacular, but none the less effective, manner every one defines his problems, creates new mental horizons for himself, and becomes more effective in making his adjustments to life.

Professor Carr mentions the following advantages of reasoning over trial-and-error learning: (1) Reasoning can be applied to a much wider range of problems. In the trial-and-error method, the material must be present. In reasoning, the materials used need not be present. A contractor in Chicago may direct the construction of a building in Seattle or Peking. (2) Reasoning can best be used — in fact it is about the only method which can be used — in solving abstract problems. Reasoning is the method used for solving problems in history, mathematics, ethics, and religion. (3) Reasoning can solve many types of problems effectively because it can utilize the experiences of others.

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CHAPTER X

EMOTIONAL BEHAVIOR

XLV. Emotional Behavior Primarily Physiological Adjustment

Emotional reactions are primarily concerned with the adjustments of the bodily organs concerned with the maintenance of life. Although these reactions in themselves are comparatively simple, they become complicated through relationships with more complex forms of adjustment. How they become intertwined with the higher intellectual processes and influence them is the subject of discussion in this chapter. An understanding of the simple physiology of emotional reactions will enable us better to understand complex emotional behavior.

Visceral Tensions. In all probability the most primitive forms of emotional response are vague, undifferentiated visceral tensions; that is, tensions of the smooth muscles. In Chapter II we discussed the characteristic activity of the smooth, or unstriped, muscles. They respond relatively slowly to stimuli and remain in a state of contraction for a long period of time. Successive stimuli can, therefore, produce a state of marked tension which will last for indefinite periods.

The nature of the stimuli which bring about tension of the smooth muscles in the viscera is not clearly known but they are supposed to be a combination of physical and chemical factors. Chemical stimuli, for example, can produce tension of the stomach walls. Blocking of the intestines may produce a distention which will cramp the smooth muscles in the intestinal walls.

It is quite likely that another effect of such tensions is to stimulate glandular activity. Through the secretions thus produced and discharged into the blood stream, the individual responds to these tensions. The thyroid, pituitary, and adrenal glands, which discharge their secretions directly into the blood stream, affect the general bodily tone of the individual.

This theory is corroborated by the fact that early reactions to smooth-muscle tensions are very vague and undifferentiated. The newborn child, when he becomes hungry, will cry, kick, wave his arms, and show that he is uncomfortable. An animal, when chemical reactions in its sexual organs become pronounced, will become very much excited and make many queer reactions.

These tensions, therefore, furnish what have been described as fundamental drives, such as the hunger and sex drives. They consist of an increase in tonus which may become so excessive that the individual will go to all sorts of extremes to gain relief.

Even adults are often not clear as to the source of these tensions. Nausea may be felt as a headache or intestinal cramp. Intestinal cramp may be mistaken for hunger. Sex excitement may be thought to be nausea or shivering from cold.

Control of Viscera through Autonomic Nervous System. The smooth muscles are controlled through the autonomic nervous system, as was illustrated in Figure 14. A nerve current coming through sensory fibers to the central nervous system, as we have already seen, sends a current out through motor fibers to muscles and glands and produces what we have termed a reflex action. In addition to this type of reaction, some of the nervous energy coming to the central system passes out through intermediary fibers to the ganglia of the autonomic nervous system, and thence to the smooth muscles of the body. Consequently, every sensory stimulus has the possibility of influencing in some degree the tension of parts of the smooth musculature.

Certain types of stimuli passing in this manner through the central nervous system and the autonomic nervous system may stimulate the smooth muscles to greater tension; other types of stimuli may cause relaxation. Just how this is done is not clearly known, but it is supposed that stimulation of the middle, or thoracic segment, of the autonomic system will cause tension of certain smooth muscles and relaxation of others, whereas stimulation of the cranial and sacral segments will produce antagonistic reactions of the same smooth muscles.

Stimulation of the thoracic segment will cause: dilation of the pupils, increased stimulation of the tear glands, decreased secretion of the salivary glands, stimulation of the smooth muscles around the hairs of the body (in animals the hair will stand on end, in man there will be goose flesh), stimulation of the sweat glands, increase in rate of heartbeat and respiration, stimulation of the larynx, inhibition of the activity of the alimentary tract, and acceleration of the secretion of the adrenal glands. Stimulation of the cranial segment of the autonomic nervous system will have just the opposite effect upon all the organs mentioned.

In combination the responses resulting from the stimulation of the thoracic segment create excitement of some sort; those resulting from stimulation of the cranial segment produce repose.

Somewhat the same antagonism exists in the stimulation of the thoracic and sacral segments.

Emotional Reactions of Infants. When the life processes are functioning normally, there is slow peristalsis of the stomach and intestines, normal secretions of digestive fluids, and general relaxation of the skeletal musculature. When, by a chemical stimulation within the body or by a sensory stimulus from the sense organs, the life processes are threatened, a reverse condition obtains. Then man becomes active in his attempt to remedy the situation and safeguard his life processes.

In the infant these reactions are much the same for a great variety of stimuli. Many attempts have been made to provide an elaborate classification of emotional reactions in the infant, but these are merely the reading of adult interpretations into childish behavior.

Watson was the pioneer in discarding old elaborate classifications of emotions. He thought he could distinguish but three emotions in young children — namely, *fear, rage,* and *love.* By making a loud sound, dropping the child, or jerking away the pillow on which the child was lying Watson thought he aroused fear. By hampering the child's movements, he aroused anger. By stroking the child or by rocking and fondling him, he aroused love.

Sherman has performed some experiments which indicate that even Watson's classification is too elaborate. Sherman's results are in agreement with what has been learned from the anatomy of the autonomic nervous system and with the experimental work done on animals. It is quite likely that we have only two inherent types of emotional reaction: tension and relaxation.

Sherman produced general bodily activity and crying by means of a number of stimuli: hunger, pin pricks, hampering of movements, loud sounds, and dropping through space. Having produced this excited behavior, he permitted judges to decide what emotion was present. He found the greatest confusion in the judgments. In other words, the classifications with which we are familiar are the result of our seeing the stimulus applied and interpreting the emotion in terms of the stimulus.

Any mother with a crying baby knows the difficulty of determining the nature of the stimulus which has caused the crying. It is not easy to decide whether the child has a pain in his stomach, whether he is being pricked by a pin, whether some sound has frightened him, or what not. In short, the emotional patterns present in a newborn child are very vague and undifferentiated. Specific emotional reactions must be learned. We can discover but two types in the infant: tension and relaxation.

XLVI. Emotional Learning

Certain types of stimuli are more effective than others in producing emotional behavior. Other stimuli, naturally ineffective, may become effective through learning. When this occurs in the adult the emotional behavior is very intricate.

Emotional Rhythms. Since the vegetative processes of the body are in continual change, the relative tension of the various parts of the smooth musculature is also continually changing. Furthermore, we are continually receiving stimuli from the external world which influence these tensions. Some of these changes are beyond our control and must inevitably take place; others are subject to definite modification.

There is evidence that definite rhythms take place in certain visceral tensions which are somewhat independent of external conditions. Probably these depend upon chemical rhythms in the body. For example, hunger increases tensions which the individual usually tries to relieve by the ingestion of food. If, however, he is unable to procure food, in time the hunger will abate; then increase and abate in a sort of cycle. If this cyclic reaction is permitted to continue without the partaking of food, the hunger tensions will after a time cease, and, even though the person is starving, he will not feel the pangs of hunger.

This principle has a direct application to more complex forms of emotional life. If a person is made angry, his anger will subside somewhat if he is given enough time, even though the stimulus to anger remains. A person in deep sorrow eventually ceases to feel the tensions of sorrow. Fear will eventually die down.

To be sure, the period of relaxation in any of these cases may not be of long duration if the stimulus to the emotional tension remains. There will likely be a cycle of reactions, but eventually the reactions will become less intense. Consequently, if you have to deal with a person who has a violent emotional reaction, the best thing to do is to allow him time enough to relax from the tension. Since, as we have pointed out, the contraction of the smooth muscles is slow in its action and is accentuated by glandular secretions which accompany it, one cannot expect the relaxation to come quickly. The ordinary tendency to talk and sympathize is often not a means of helping relaxation but rather a method of prolonging the emotional stimuli and accentuating the tension. The best comforter in trouble is not the one who loudly weeps with you, or tells you how unfortunate you have been, or points out how much worse your trouble might have been. The understanding comrade merely sits with you, understanding that your emotion must run its course, and helps you to relax by being relaxed and calm himself.

The cyclic character of emotional tensions often leads to a change from one type of emotional reaction to its opposite. The greatest relaxation comes after extreme tension. The person suffering from grief who will not permit himself to cry or express his emotion is not only cutting off the extreme of tension, but he is also preventing himself from completely relaxing. This explains why some persons enjoy a good cry. The crying is merely an expression of an extreme of tension which has been followed by a most welcome relaxation. The person who goes to emotional extremes, the unstable type of individual who is always laughing or crying, is one who has come to gain an unwholesome amount of pleasure from his emotional cycles.

Characteristics of Unlearned Emotional Responses. In order to understand how to train emotional reactions, it is essential to know some of the characteristics of unlearned emotional behavior.

1. *Emotional behavior is reflexive.* Experimental work has shown very clearly that emotional behavior is reflexive in its nature. Removal of the cortex of an animal results in a sort of sham rage which manifests itself as follows:

> . . . vigorous lashing of the tail; arching of the trunk, and thrusting and jerking of the limbs in the thongs which fasten them to the animal board, combined with a display of claws in the forefeet and clawing motions, often persistent; snarling; rapid head movements from side to side with attempts to bite; and extremely rapid, panting respiration. These activities occur, without special stimulation in 'fits' or periods, lasting from a few seconds to several minutes. During the intermediate quiet stages a 'fit' could be evoked by slight handling of the animal, touching the paws or jarring the table. Besides these changes which involved skeletal muscle there were typical and more permanent effects produced by the sympathetic impulses: erection of the tail hairs, which recurred again and again after they were smoothed down; elevation of the vibrissae; sweating of the toe pads; dilation of the pupil to a size during activity that was threefold the size during a preceding quiet period; micturition; a high blood pressure; an abundant outpouring of adrenalin; and an increase of blood sugar up to five times the normal concentration.[1]

This behavior of a decerebrated animal is typical of the emotional spasm one may observe in an infuriated child or animal.

[1] Cannon, Walter B., *The Wittenberg Symposium on Feelings and Emotions,* p. 259. Clark University Press, 1928.

If one was stimulated to anger and exerted no control over his reactions, he would do the things which this animal did. The internal reactions are of the sort to accentuate these processes. There is an increase in the secretion of adrenalin, as we have previously noted, which incites to increased and general activity.

Cannon, on the basis of these and other experiments, believes that they serve as a pattern, and he furnishes evidence that other emotions are likewise reflexive in nature. It is well known that a person in the "second" stage of anesthesia may manifest emotional reactions, although, after recovery from the anesthetic, he has no memory of having done so. The person who laughs or weeps copiously when under the influence of laughing gas also illustrates this reflexive nature of emotional behavior.

Even in later life when we have learned to gain control of these reflexive emotional reactions, they may persist in their primitive forms. For example, Dashiell cites the case of a little boy who although very much frightened kept his outward composure. Later the boy explained to his father: "I was not frightened but my stomach was."

2. *Emotional reactions are unitary.* The skeletal reflexes are very specific in nature. Light shining in the eye will cause the pupil to contract. A tap on the patellar tendon will cause the knee jerk. The reason for these responses is found in the specific nature of the neural reflex connections in the cerebrospinal system.

The autonomic nervous system, on the other hand, has a very definite central station which sends out motor fibers to the whole range of smooth muscles. The great number of organs involved in the emotional excitement of the decerebrated animal just described are all under the control of the same center.

3. *Emotional learning is more skeletal than visceral.* We

have seen that an emotional stimulus causes certain activities in the viscera and at the same time a number of reactions of the skeletal system. These skeletal reactions often provide a means of readjustment whereby the individual is able to rid himself of the emotional stimuli. Hunger may lead to violent visceral reactions, but one stops hunger by getting something to eat. When a dog sees a cat, he may have violent visceral disturbances; but, at the same time, he gets rid of the cat either by fighting her or running away from her. In other words, the place of the visceral disturbances in life is to make the individual do something to rid himself of the annoying stimuli. He may not know what to do, but he will do something, the violence of his reactions being related to the intensity of the emotional disturbance.

What happens when a person learns emotionally? A child pricked by a pin will go through the violent reactions of the decerebrated animal. The adult pricked by a pin will remove it. He may suffer very little emotional reaction. What is the difference? As we have previously stated, the incoming nerve impulse from the pin may branch into various pathways. Part goes through the autonomic nervous system and causes the visceral reactions. Part goes to various parts of the skeletal system and makes the child act. If, on his first movement, the pin is removed, there is no further response. If the pin is not removed, more energy goes to the autonomic system, and the child is incited to renewed energy. Eventually in his activity, he does something to remove the pin. This experience need not be repeated very often before the child comes to have little emotion and very little excitement of his motor organism. For these he substitutes a simple act of removing the pin when he feels it.

In other words, a large part of the learning of emotional control is learning to make specific reactions to situations which otherwise would have a violent effect on the autonomic system and the smooth musculature.

Emotional control is not learning to endure a stimulus which is distasteful or obnoxious, but learning to do something specific about it. The learner comes to respond to stimuli, not by more violent visceral disturbances, but by more specific skeletal acts. He ceases to cry when he feels the pin; he removes it. The basis of emotional learning is the control of the environment, not the control of our emotional expressions.

Methods of Emotional Learning. The methods whereby we develop emotionally are little different from those of ordinary learning, which we have already discussed. They may be classified into four groups: negative adaptation, fixation of random responses, substitute stimulus, and substitute response.

1. *Negative adaptation.* Thunder may frighten me. I may go through all the physiological reactions of fear, but none of them does much good because I still hear the thunder. If the thunder continues long enough, I may finally become accustomed to it and no longer respond emotionally.

In situations where the stimulus really has little significance for me, and where there is nothing that can be done to avoid it, negative adaptation is an effective type of response. I do the only thing I can do — namely, nothing. Of course I might move to Seattle, where there are no thunderstorms. I might run to my mother and cling to her. Each of these reactions illustrates a substitute response, to be discussed later. They are mentioned here to indicate that the method of negative adaptation may not be applied exclusively to any particular situation.

Because negative adaptation is effective in some instances, its merit has been overemphasized by some persons. It has led to the development of the doctrine that the way to train the emotions is to endure to the point where the organism becomes impervious to stimuli of an emotional nature. Experiments in the field of abnormal psychology seem to indicate that this method has been stressed too much. It is really better to permit negative adaptation to operate as a last resort, when other methods of adjustment have failed.

2. *Fixation of random responses.* We have seen that the primitive form of emotional reaction involves a great number of movements that have little logical relation to the situation at hand. From this welter of activity some act may serve to relieve the situation and thereafter be given preference. This is a very useful form of adjustment and fortunate is the individual who, through chance or wise education, learns the most efficient type of response and fixes on it.

In some instances useless types of random movement become fixed. If you watch persons when they are under some tension, you may observe many of these acts. One man will make queer grimaces, another will rub his hands, another will bite his lips, another will twist his clothing, and so on in endless variety. If you are observant, you can get from these reactions many clues as to the degree of tension in others. One man confessed that he could always beat a friend of his at poker because whenever his friend had a good hand, his Adam's apple moved up and down.

Sometimes these reactions take more pronounced form. A girl who was confronted with a particularly difficult task was so frightened that she was nauseated. Thereafter she was always nauseated when she had to face any hard task. Even when she had reached the age of thirty-five, this woman was severely nauseated just before she was to appear on the platform in a musical performance.

We have seen how essential it is in motor learning to eliminate useless movements, even though they are part of our random activity at the beginning of learning. We may press our foot on the floor with great vigor or make a wry face every time we strike a key when we are beginning to operate a typewriter, but we soon get rid of such a useless act. It is just as silly to persist in some random response in an emotional situation. Random activity is valuable in that it gives us a variety of responses from which to choose the best, but it becomes a handicap when we persist in some silly act.

In emotional life we get rid of such random, useless acts by positive means. We place all the emphasis upon some response which is more useful. When a person finds himself the victim of some foolish emotional behavior, he needs to get some positive way of dealing with the situation instead of telling himself he must not let his emotions control him.

3. *Substitute stimulus.* Very few things produce emotional responses in infants. Adults respond emotionally to thousands of things. Why do so many things produce such responses in adults?

We have said that Watson found that a child will respond to loud sounds, to sudden movement through space, to restraint, to gentle stroking, or to pain. The range is indeed limited. No child is innately afraid of lights, of animals, of the dark, or of persons. He loves comfort, but he has to learn to love his mother or nurse. He learns to respond to all these things through the mechanism of conditioned reacting — by the method of substitute stimulus.

Watson demonstrated the function of the conditioned reflex in emotional life in this way: He permitted a child to stroke a rabbit. The child showed no emotional reaction of fear toward the rabbit. When a loud sound was produced in the vicinity of the child's ear, he did respond in a way which Watson called fear. When the loud sound was made at the same time that the child put out his hand to stroke the rabbit, the child related the two and soon became afraid of the rabbit; that is, he cried whenever he saw the rabbit. He had learned to be afraid of it.

After he had made the child afraid of the rabbit, Watson then set about to make him overcome the fear. He found that the most effective way was to make the rabbit a part of a situation which was emotionally desirable. When the child was eating a particularly pleasant food, the rabbit was permitted to come into a distant corner of the room. After a number of such experiences, in which the rabbit was not connected with anything unpleasant, the child endured the rabbit, and finally learned to respond to him as part of the total pleasant situation. Eventually he learned to like the rabbit. In short, the child used the method of substitute stimulus to overcome a fear which had been established by the same method.

There is a danger in this method. It is conceivable that the dislike and fear of the rabbit could have been so strong that, instead of the desire for the food making the child like the rabbit, the fear of the rabbit might have carried over to make the child fear or dislike the food. This would surely have happened if the rabbit had been introduced too quickly. In such a manner we can be made to fear things far removed from any original fear response.

There exists a group of fear reactions, commonly known as phobias, which have quite as specific stimuli as the simpler emotional reactions, but which do not yield to detachment by the methods just described. Individuals suffering from phobias are unable to recall the experiences which originally caused the fear. For this reason, the phobia continues to affect them.

Phobias are more common than one would suppose. Fear of water, of high places, and many similar phobias are often very embarrassing and painful to the person possessing them.

Professor Prince reports an interesting example of a phobia, together with the methods employed to eliminate it.[1] A young woman suffered from a fear of church bells. She had forgotten how the fear began but, through the use of a special

[1] Bagby, English, *The Psychology of Personality*, p. 51. Holt, 1928.

technique, it was discovered that the condition dated from the death of her mother, and that her childhood reaction to the death had been important in the genesis of the phobia. The woman had felt that she was responsible for the serious turn of her mother's illness because she believed that she had not been giving her mother the proper care. While the woman was in this state of agonized distress, the bells of a neighboring church were continually ringing, and her fear became attached to them. All of the episode was recalled by the young woman, but still detachment was not effected. The belief that she was responsible for her mother's death was no more acceptable to the woman as an adult than it had been to her as a child. The thought could not be assimilated; that is, it remained a source of fear. Prince found it necessary to give his patient reassurance so that she might react to her memory without fear. He dissipated her thoughts of self-reproach by convincing her that the death of her mother had been due to an uncontrollable sequence of causes, and that her own actions had not only been above reproach but were actually remarkably fine. It was not until the woman was brought to this belief that she was able to overcome her phobia.

4. *Substitute response.* We are fascinated when some person tells of being afraid of an object which should not ordinarily produce fear. But these conditioned fear-stimuli are only a small part of the emotional pattern. There are other stimuli, emotional in character, which produce an emotional reaction. The treatment in these cases does not consist of substituting stimuli of another sort, but of changing the response. If my best friend dies, I am justified in mourning. Shall I try to make the death of my friend part of a pleasant situation until I learn to laugh like an idiot every time I think of it? You have probably seen persons attempting to adjust to an inevitable misfortune in some such manner.

We have already indicated that justifiable emotional situations may be met by negative adaptation, but that this should be used as a last resort. We have also indicated that fixation of random reactions is likely to lead to silly responses. Substituting some pleasant stimulus may be effective, but the best plan is to learn to get some substitute outlet — some substitute response.

The end of emotional behavior is not visceral tensions or extreme skeletal activity. These come when it is essential that we do something radically different from what we have been doing. They incite us to do something different. The activity that results from them should lead to a better adjustment to our environment.

Certain kinds of substitute emotional responses are very little improvement; they may be merely the substitution of one visceral tension for another. These responses of questionable value come usually as a substitute for certain visceral tensions which we have been taught are morally undesirable. The child is taught, for example, that he should inhibit sexual tensions. Consequently, we see adolescent boys and girls making a vast number of substitute reactions. They giggle, blush, and chatter. Some have queer lumps in their throats. One girl became nauseated every time a young man called her on the telephone to ask for a " date." A substitute type of response which modern society approves and which a large number of young people find relatively successful is the development of romanticism. The sexual tensions find an outlet in idealistic responses to an ideal lover, the imagining of a permanent and ideal attachment, and the development of a home.

Tensions tend to last until the person does something. A person who has lost a loved one will mourn until he decides that the departed one would prefer that he do something worthy, instead of pining. When the person undertakes some activity, the tension ceases. He has substituted an overt act for a smooth-muscle tension.

When a person is awakened in the middle of the night, terrified by some strange noise, the terror will remain if he lies in bed and does nothing. If he gets up and investigates, he substitutes an activity for the fear, and the emotion subsides.

The principle of emotional learning is to do something, but that something must be in the nature of a real adjustment, not simply activity. Some persons, with a shortsighted view of the situation, have advocated doing anything — yelling, throwing dishes or the furniture, exploding in some way to get rid of the tension. These persons are right in so far as they suggest activity, but they are wrong when they suggest a line of activity which produces a greater maladjustment to the environment than the one they seek to alleviate.

XLVII. Types of Emotional Reactions

Emotional behavior has always defied classification because of complexity. We shall not attempt to classify the emotions, but merely to look at them from three different angles: from the personal angle we have joy and sorrow; from the angle of adjustment to difficulties, we have fear and anger; and from the angle of our relations to others, we have love and hate.

Joy and Sorrow. From the subjective side, emotional life may be classified into the two divisions, joy and sorrow. When life's processes are moving forward in a satisfactory manner, we have the subjective feelings of joy; when something comes in to disturb them, we have feelings of sorrow.

Joy is merely the subjective experience one has when both tension and relaxation are part of a successful adjustment. There is a thrill in exertion, both mental and physical, and also a thrill in a well-earned rest. If one is forced to rest when there is something he should be doing, he is unhappy. If he is forced to be active when fatigued and in need of rest, he is unhappy. One enjoys hunger as well as satiety, but excessive hunger or satiety is unpleasant.

These subjective phases of emotional life are not the primary function of emotions. The person who is intent on making himself feel good will soon find that he is not accomplishing his objective. Joy gives one an urge to continue the type of conduct which is making for a successful adjustment, and sorrow gives one an urge to change his mode of reaction. A person should not ask himself: " How can I be happy? " This centers his attention on his viscera and not on his adjustments. If he is unhappy, he should ask himself what he is doing that is wrong. Unhappiness is a sign that a person is adjusting poorly. He should search for something different to do, and his happiness will take care of itself.

Fear and Anger. When emotions are viewed from the angle of what a person does, they fall into the two groups, fear and anger. Of course there is a subjective aspect to these emotions, but the visceral behavior is very little different in the two. The main difference lies in the kind of response that is made, whether the person is making an overt aggressive response or is retiring from the difficulty.

The first response to thwarting is an aggressive type of conduct. If a child is held so that he cannot move, he will resist the restraint and fight. If his resistance is overcome and he is made to suffer for attempting to resist, a condition of inactivity or fear results. When this condition is pronounced, the muscles become paralyzed. The child is tense, but he cannot do anything.

The transition from anger to fear and from fear to anger is often very sudden and very easily accomplished. An animal may begin to fight an enemy. Getting the worst of it, he may run. Being cornered, he may tremble in a paralysis of fear; but if threatened too insistently he may turn and fight with extreme energy.

A person may develop a habit of reacting to difficulties by either fear or anger. In some instances the habit of fear may be justifiable. One should have a fear of foolhardy things. But if a person reacts with fear too frequently, he may become a slave, a mere tool of others who are not so motivated.

At various times in the history of the world fear and anger have been predominant in the activities of the majority of men. Savages were held in check by superstitious fears of things they did not understand. During the Middle Ages men were motivated by fear. To-day in this country there is a predominance of aggressive behavior and people are afraid of very few things. Other nations look on in horror waiting for us to meet with some catastrophe. From the point of view of Americans, progress follows when men are unafraid. We are placing emphasis in our modern life upon aggressiveness and spontaneity instead of upon obedience and senseless fear, and the results seem to indicate that our emphasis is sound.

Men who have to handle other men can get a lesson from the interplay of fear and anger. If you desire men to act as mere machines, to do nothing but what you tell them, then train them to be afraid to disobey you. If you want them to show initiative, then teach them to resist difficulties, to be unafraid to do things differently. The fearful person learns far less than his fearless brother. The child who sits trembling at the foot of the tree does not learn to climb; the child who is fearless climbs to the top. Which is better: to learn to climb at the risk of breaking a leg, or to play safe and never learn?

Certainly the person who is fearless has a great advantage over the fearful one. The author knows two boys who played hide-and-seek together. One of them was afraid of the dark, the other was not. The boy who was not afraid of the dark would hide in a closet where the other boy did not dare to come, and so was able to win the game. This story typifies what is happening continually in adult life. While the fearful person is hesitating, questioning whether he dares to do a thing, the fearless one is getting the thing done.

It must not be forgotten, however, that there is a place in life for legitimate fear. More than a thousand people are killed each year by automobiles in the city of Chicago alone. Many thousands more are maimed and injured. We should maintain a healthy fear of getting in front of a moving car. It is foolhardy to work with high-tension electric-light wires without testing them first to see whether they are charged. Uncovered high-speed gears and poisonous gases take a large toll of lives each year in industry. There is always more or less danger in any type of activity. We should be courageous but not without counting the cost.

Love and Hate. We cannot as a rule react to our environment without reacting to other human beings. For this reason, people furnish the stimuli for many of our emotional reactions. Social emotional reactions are not essentially different from those already described, but the complications which arise make their expression unique.

In normal development of emotional attitudes toward others we usually go through a series of stages which, while not uniform and regular, are at least distinguishable.

1. *The egocentric stage.* In infancy a child becomes tense when he is physically uncomfortable and relaxed when he is comfortable. Human beings are no more to him than any other objective factor which contributes to the sum total of his comfort or detracts from it. He loves only himself, because he has not learned the significance of any adjustment to other persons.

2. *The stage of parental love.* Soon the child discovers that his comfort is dependent upon the ministrations of his mother, nurse, father, or other members of the household. They become substitute stimuli, and his happiness depends upon their conduct. Since the mother is usually primarily involved in his

early comfort, she is likely to be the first object of his attachment. If other children in the household interfere with his satisfactions, they may become emotional stimuli of a negative sort, stimuli to arouse hate and jealousy. If the other children help to make him comfortable, they will evoke favorable responses.

3. *The gang stage.* After the child grows older, he broadens his contacts and learns to respond to other children, usually of his own sex. This stage has often been called the homosexual stage, but there is really little significance in the fact that his friends at this stage are of his own sex for the reason that adults make for him an environment in which he is likely to be more happy with his own sex than with those of the other sex.

4. *The heterosexual stage.* With the onset of adolescence, he develops new visceral tensions which make his emotional reactions to the other sex different from those to his own. If his contacts with the other sex are of a satisfactory nature, he learns to include them as a part of emotional life. But if persons of the other sex make him uncomfortable and unhappy, he is likely to develop an antagonistic attitude and hate them. Most adolescent children have a series of oscillations between love and hate for the other sex which eventually terminates in that emotion which has the predominance of favorable aspects.

5. *The altruistic stage.* The final adjustment which society considers ideal is the one in which the individual has made so complete an adjustment to other persons that they become essential to his happiness. This development does not occur universally, however. Some persons have such unfortunate experiences with others that they develop an attitude of withdrawal when confronted with others. They develop an attitude of hate rather than one of love.

This development of the attitudes which we have outlined is a complication of the conditioning which we have called substitute stimuli. People become stimuli for different types of emotional tension or relaxation in a very complex manner. The adult spends a large part of his life reacting in one manner or another to social stimuli.

Another phase of social emotions is the development of various types of substitute responses. A child sits on his mother's lap, feels her hand on his face, and responds to it. He learns to talk to other people, to play games with them, to fight with them, to engage in sports with them, to be influenced by their reactions, to strike bargains with them, to take things from them, to give things to them, to sit with them in public places, to eat with them, and all the other things that make up social intercourse. So much of personality is involved in these responses that one can almost judge a person's whole make-up by the way he acts toward other persons. As it has been so aptly put, " You can tell more about a person by what he says about others than by what they say about him."

Complex Forms of Love. The child neither loves nor hates his parents instinctively. He *learns* to love his parents in the same way that he learns to love other things. The only difference between his love for his parents and for others, or even for inanimate things like food, is one of degree. The basis for the child's love for his parents is in large part the fact that it is they who provide the food and otherwise minister to his needs. In addition to providing food, the mother cuddles and pets the child. As these relationships continue, reciprocal love is built up between the mother and child.

Only when the ministrations are not forthcoming, or more often when they are unwisely given, will friction arise. In such cases instead of love, hate will develop. The conditions of the home are extended on a broader but less intensive scale in the whole social community. On such bases do social friendships and hatreds develop.

Although there are many elaborations as well as many other elements involved, the state may be regarded as an exalted family, motivated by the same needs, and shot through with the same loves and prejudices. The historic basis is not the only similarity between the home and the state. They possess the same inherent structures.

Religion and its organized expression, the church, are built upon the same foundation. The fatherhood of God and the brotherhood of man form the basis of practically all modern religions. Its expression in Jewish or Christian doctrine, or even in Mohammedanism, is only a matter of variation in form. When we try to distinguish between Protestant and Catholic or between the many sects in Protestantism, the variation of this theme becomes less and less marked.

The life of the adult is largely a matter of his relations with other persons. He is constantly dealing with the problems of likes and dislikes. These are expressed in home life, in political contacts, in business, in religion, and in the thousand and one forms in which man meets his fellows. In all of these relations fears, loves, hates, anger, disgust, and their finer gradations constitute his guiding forces. These in turn are elaborations of more fundamental drives of hunger, sex, pain, digestive processes, and glandular activities. Therefore, instead of disparaging emotional urges, we should recognize that they are neither base nor worthy in and of themselves, but according to how they are expressed and what their social consequences are. We shall learn more about this topic in Chapter XIII.

XLVIII. Relation of Emotions to Other Mental Processes

We have seen how emotions color all our activities. It may be of value to trace some of the specific connections between emotions and other typical mental processes. A recognition of the part that emotions play in such processes as attention, perception, learning, memory, and thought will help us to understand life more thoroughly.

Behavior Is Unitary. The reader may have received the impression from the preceding discussion that overt behavior is one thing, thinking another, and the emotions yet another. Such is not the case. The various processes go on simultaneously and in an integrated fashion. It is only by analysis that they are separated. The normal man is a thinking, feeling, acting individual. It is seldom if ever that one state exists apart from the others.

Sometimes a person may be seated in the quiet of his study, thinking through the solution to some abstract problem. Emotional states may seem to be entirely lacking. Many psychologists believe, however, that there is never a time during waking life when there is not at least a modicum of emotional background. It may be largely neutral, it may be tinged with hate or sadness, or it may be euphoric in character. At another time a person may be swimming or running with thinking at a minimum. When the individual is in great anger or fright, the emotional element may predominate. Even if gross activity does not accompany the emotion, as so often it does, numerous outward signs betray tendencies toward activity. Thus, it is apparent that thinking, overt activity, and emotions exist in various proportions in all behavior.

With this general consideration of the interrelatedness of life processes, let us consider more in detail some of the close relationships between certain mental states and certain emotional states.

Attention. General emotional tension makes a person more alert to the stimuli which impinge upon his sense organs. He will become aware of sights, sounds, and the like which would have passed unnoticed in periods of relaxation.

In addition to this general susceptibility due to emotional tensions, the specific nature of our attentional processes is strikingly affected. The frightened boy in the woods will notice the slightest noises and shadows, the person alone in the house will hear noises he would never hear were he not emotionally tense, the young man in love will have his attention directed to every girl's hat he sees in the crowd, the hungry man will smell the odors of cooking food which would be unnoticed were he not hungry, and so on *ad infinitum.*

Perception. Emotional attitudes also affect perception. In studying this subject we found that one interprets stimuli "not as they are but as he is"; that is, according to his emotional attitudes.

The fearful person will see danger in a situation where the aggressive person sees opportunity. The artist will see beauty in a landscape where the subdivider will see the possibilities of so many lots. One who enjoys people will ascribe to the actions of another something worthy and admirable, while one who dislikes people will attribute only vicious motives to the actions of others. Even a sunshiny day will look gray to the despondent person, while a cloudy day will look bright to one who is in a joyful mood.

It is well to remember this trait of human nature in our dealings with others. A person's attitude, even his philosophy of life, being nothing more than an expression of his emotional life, should not be regarded too seriously. If we understand this, we are better able to control his conduct.

Learning. We have indicated that learning depends upon incentive. The attitude that one takes toward the task in hand determines very largely the speed with which he acquires the new act. The rat in the maze with no interest in doing anything, with no visceral tensions, will go to sleep in the corner of the maze and never learn it. We have to make the animal hungry or angry or stimulate him in some other manner if we want him to try to learn.

In producing learning, however, the problem is not merely to bring about some sort of emotional tension. If the tension is not of the right sort, it may hinder rather than help. A teacher who shames a child because he failed may set up an emotional inhibition not only against doing any more work for her, but against doing anything in the particular subject involved. We have found adults who hate arithmetic, language, history, or some other subject because of an emotional attitude developed by an unwise teacher.

The way to get a person to do anything is to make him *want* to do it.

Memory. A person in a high degree of emotional excitement remembers more than one in a severe depression. A young man in love with a girl is not likely to forget her name or even her telephone number, but he may forget the name of some salesman he is supposed to call, and certainly the telephone number of the salesman has little chance of being remembered.

As we try to recall our past, the things which had an emotional coloring of one sort or another are the ones which come most readily.

On the other hand, there is a type of forgetting, called functional forgetting, in which some emotional strain keeps us from remembering a specific thing. If I make an appointment, but at the same time wish I did not have to keep it, I am more than likely to forget it. Even memory, supposed to be so mechanical in its operation, has been demonstrated to be subject to the emotional reactions of the individual.

Thinking. Many philosophers and psychologists have argued that the reasoning processes are free from emotional distortion. We have learned from modern experimental investigations of the thinking process that this is not so.

If we can reason about purely abstract things, there is often little emotional coloring. This is the type of reasoning that scientists attempt to employ. They reduce all their facts to algebraic symbols, or to some similar abstract form, and then juggle these symbols. But even then the scientist may be biased. Suppose he develops a theory around his symbols. As soon as he does, he is very likely to become emotionally stimulated. He wants to prove that his theory is so. Consequently, he is likely to distort, quite unconsciously, all the relevant factors in order that they will fit into his reasoning.

The name that psychologists have used to designate this process is *rationalization.* The process consists, briefly, in the adoption of some statement, theory, line of conduct, or the like and then searching for reasons to prove that it is rationally sound.

The wise man does not delude himself into thinking that any part of his life is free from the influence of emotional tensions. Instead he recognizes that his thoughts and acts are colored by his emotions and gives due consideration to the possibilities of such influence.

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CHAPTER XI

MENTAL ALERTNESS

XLIX. What Is Intelligence?

As the complexities of life increase, men show marked differences in their ability to make satisfactory adjustments to the problems which confront them. Why do they differ in this respect? Is it because of inherited capacities or is it due to training? Let us see what answers have been given to these questions.

Individual Differences in Intelligence. Thus far we have been largely concerned with general principles. We have studied the behavior patterns that we should expect to find in most persons and have touched only incidentally on the way in which these may differ. In this and Chapter XII we shall be concerned with some of the important ways in which persons differ. The present chapter will deal with the problem of intelligence, and the following chapter with individual differences in other traits of personality.

Individuals differ in every trait that we can mention. Obviously, they differ in weight and height. The fact that we can identify our friends among the hundreds of persons we see proves that people differ in physiognomic characteristics. Our jails testify to individual differences in morality or amenability to the social order. Bank accounts prove that men differ in their material possessions, and store clerks will bear witness that people differ in their tastes.

In *The Declaration of Independence* appears the statement that " all men are created equal." This statement is quoted by some unthinking persons as evidence that our democracy is built upon the philosophy that there are no individual differences. The philosophy of democracy holds that each person should have an equal right to live his life as he sees fit, limited only by consideration for the rights of others. The full quotation which makes the meaning clear is: "We hold these truths to be self-evident: That all men are created equal; that they are endowed by their Creator with certain unalienable rights; that among these are life, liberty, and the pursuit of happiness." It is equality of opportunity to which *The Declaration of Independence* refers and not equality of height, weight, tastes, morality, ability, or personality.

The average man would not enjoy being treated as though he were Einstein; he would not understand the abstract statements that would be made, and he would be bored by the technicalities involved. Nor would he want to be treated like an idiot — spoon-fed, nursed, dressed, and ignored in any serious situation.

The whole secret of social adaptation is an understanding of the differences in people and the ability to treat each one differently in just the proper degree. Some of our differences we are ashamed of and attempt to conceal. Of other of our differences we are extremely proud. We wisely ignore the undesirable traits in another and acknowledge his praiseworthy ones. Nevertheless, we recognize that he is different and he honors us for treating him differently.

Intelligence is a characteristic of which a person is often either proud or ashamed. He is ashamed if there is the slightest intimation that he lacks it, or extremely proud if he thinks he excels in it. This should not be the case. One should be able to recognize his intellectual status and order his life accordingly. As we shall show presently, intelligence is only one of many traits that one may possess. If a person is not so alert as his companions, he may by more persistence and industry keep abreast. Indeed, it sometimes happens that the alert person becomes so vain that he grows lazy in his habits and is surpassed by his slower but more persistent comrades.

Definitions of Intelligence. It is not easy to define intelligence. Many definitions have been given, but none of them is entirely satisfactory. The one which has had the widest acceptance was given by Stern, a German psychologist. He defined intelligence as the ability to meet and solve novel situations.

The most serious difficulty with this definition is that it does not make clear what he means by a novel situation. Some kinds of situations require one type of ability and some kinds require another. The evidence seems to show rather conclusively that a person who is able to solve one type of problem may not be able to solve another type. A man may be able to learn music or football and not be able to learn trigonometry.

Another definition of intelligence which has often been given is that it is the ability to learn. This definition presents the same difficulty as the preceding one, but it has the advantage of being more concrete. If we take school work as a measure of ability to learn (admitting that it is not a perfect measure, but probably the best there is), we have something with which to compare or measure intelligence. On the other hand, we have all known persons who have a wealth of knowledge in some particular but who are not able to use it. This definition of intelligence, then, should include the ability to apply what has been learned.

Probably the best definition is the one that characterizes intelligence as the ability to make successful adjustments to the problems of life. This definition implies that a person has learned a number of ways of responding; that is, he has formed a large number of satisfactory bonds between stimuli and responses. In addition, it implies that he knows how to apply this learning to the problems of life as they arise. If a person can make many successful adjustments, he is intelligent; if he cannot make successful adjustments, he is, to the degree to which he is incapable of making them, unintelligent.

It is this third definition of intelligence which we shall use in our discussion.

Factors in Intelligence. Two factors are indissolubly bound together in intelligence. One is the innate factor and the other is the environmental factor. There can be no intelligence with either of these factors absent. Furthermore, it is practically impossible to determine in any situation just what part of the individual's reaction is learned and what part is inherited.

All intelligence must be founded upon an innate basis. We do not know what all these innate factors are. Undoubtedly, certain characteristics of the nervous system, such as the number of neurones, the complexity of their inter-connections, the permeability of the synapses, and the retentivity of the synaptic connections, as well as several other less apparent factors, form the innate background of intelligence. It is apparent that intelligence is not dependent upon some single or unit character, but upon a number of inherited factors. Because of this complexity of factors, many different combinations are possible. Generally the child is like one or both of the parents, but this is not always true. Inheritance of intelligence cannot be explained upon any simple Mendelian ratio. But it can be accounted for by assuming a number of dominant and recessive factors. By such an assumption only can we account for the occasional mentally inferior child of mentally superior parents, reared in good home conditions.

These innate elements of intelligence cannot exist unmodified by environmental influences. If the innate factors are favorable and the training good, the intelligence will be high. If the innate factors are favorable and the training poor, the intelligence will be mediocre. If the innate factors are poor and the training good, the intelligence will be low to fair. If the inheritance is poor and the training poor, the intelligence will be low.

It is not to be inferred from this discussion that a good environment or good training can compensate for very low innate ability. A certain capacity must exist or the best of training can do little good. But if there is a fair degree of ability, training can greatly improve the individual.

Two equally fallacious doctrines have been held concerning intelligence. One of these maintains that there is little difference in real ability among persons. This point of view is expressed in the saying: "Success is nine-tenths perspiration and one-tenth inspiration." This is a comforting thought, but it has one serious fault: it is not true. Witness the great number of serious-minded, hard-working individuals who never succeed. Even if the author practiced faithfully for a lifetime, he could never run a hundred yards in 9⅖ seconds or write 245 words per minute on the typewriter. On the other hand, although he has had no special practice, he has never found anyone, among the few thousand whose records are known, who can equal his record in strength of grip. The fact is, we inherit abilities in certain traits and disabilities in others.

The other doctrine, equally fallacious, holds that intelligence is innate and cannot be influenced by training. If this doctrine were literally true, why have institutions of learning? The intelligent person would be sure to succeed anyway, and we could not help those with limited ability. Although very few hold this extreme view, a doctrine of determinism or fatalism is sometimes preached which is extremely pernicious. Training does not improve the innate capacity, but, as has already been said, it can make the best of what there is, and this is a goal which is never fully attained.

Several experimental studies lend credence to this view.

Baldwin, Lincoln, Rugg, and others have found that when a child remains in his normal home environment, his intelligence level does not change much (seldom more than about five points in a hundred). But Terman and Yerkes have both shown that the social level of the parents influences intelligence-test scores. Terman says that of children of the same native ability, those coming from superior homes make a score about ten points higher than those coming from inferior homes. Freeman has recently shown by an interesting study that the intelligence-test scores of children may change when the children are adopted into other homes. The greater the change in the conditions of the home, the greater the change in test scores. In some cases, as a result of a few years in a superior home, the intelligence-test level was raised as many as fifteen or twenty points.

L. Description of Tests of Intelligence

The most widely used intelligence tests are adaptations of the Binet-Simon Intelligence Scale. Since this scale requires some language ability, it is not suitable for use with illiterates and foreigners. Performance tests have been devised to fill this need. The Binet-Simon and performance tests are individual tests; that is, they require the entire time of one examiner to examine one subject. Group tests have been devised and are now widely used. With these tests one examiner can examine a group of subjects simultaneously. Group tests are not so accurate as individual tests, but they are very valuable in making surveys of large groups of persons.

The Binet-Simon Intelligence Scale. In 1904, Dr. Alfred Binet and Dr. Theodore Simon were given the task of finding out which children in the Paris schools needed special instruction. The result of this commission was the construction of the first successful intelligence test.

The general procedure in the Binet-Simon Intelligence Scale is for the examiner to ask the subject certain questions and give him certain problems to solve. If the subject answers in accordance with certain definite standards, which the examiner must use, he is given credit. If his answers do not meet these fixed standards, he is not given credit for that particular item.

The questions and problems of the test are grouped according to years. For each year from three to eighteen, there are from six to eight problems. The items included in any year-group were placed there because, in the experimental trials, seventy-five per cent of the children of that particular age answered that item correctly. That is to say, the items of the test are placed where they are, not because of any theoretical assumption that they should be answered at that particular age level, but because on actual trial it was found that they were answered at that level. This method of standardizing tests by trying them out on a number of subjects is known as the empirical method of test standardization, and is the method which has guided practically all the successful developments of tests since the time of Binet.

Not all the items in the scale are given to any one subject. It would obviously be a waste of time to give an eight-year-old child of normal intelligence every question from the three-year level up to the superior-adult, or eighteen-year, level. Instead of giving all the questions, the examiner goes low enough on the scale for the subject to answer correctly every question in a single year, and high enough for the subject to fail every test in a single year. In addition, the examiner gives all the problems in every year between these two extremes. By averaging the results of this testing, the score of the subject can be expressed in terms of mental age. For example, suppose a child passes all the six-year tests, gets credit for eight months in the seven-year tests, gets credit for two months in the eight-year tests, and fails all the nine-year tests. His mental age would be six years (the level at which he passed all the tests), ten months (the additional credit for tests passed in years seven and eight).

If a child eight years old makes a score of nine years on the test, such a score has quite a different significance from a similar score made by a ten-year-old child. The final score should not only indicate what a child accomplished but should also show how his accomplishment is related to what he might be expected to accomplish. In order to express this relationship, the child's final score is expressed in terms of the intelligence quotient (I.Q.). The I.Q. is obtained by dividing the mental age (M.A.), as obtained on the test, by the chronological or actual age (C.A.). The I.Q. for all persons with a chronological age above 16 is obtained by dividing by 16, regardless of the actual chronological age of the subject.

Sample Items from the 1911 Revision of the Binet-Simon Scale

Age 3.
1. Points to the nose, eyes, and mouth
2. Repeats two digits
3. Enumerates objects in a picture
4. Gives family name
5. Repeats a sentence of six syllables

Age 9.
1. Gives change for twenty cents
2. Defines familiar words in terms superior to use
3. Names the common coins
4. Names in order the months of the year
5. Answers easy questions on comprehension

Age 15.
1. Repeats seven digits
2. Finds three rhymes for a given word
3. Repeats a sentence of twenty-six syllables
4. Interprets pictures
5. Interprets given facts

The Binet-Simon tests have been translated into English, revised, and adapted to American conditions. The most widely used adaptation is that made by Professor L. M. Terman and is known as the *Stanford Revision of the Binet-Simon Intelligence Scale*. Other adaptations are the Kuhlmann Revision and the Yerkes-Bridges Point Scale.

The examination takes about an hour and can be given only by a trained examiner. Although the tests may be used with adults, they were especially designed for use with children. They are not so satisfactory for the higher grades of intelligence. For these reasons, the tests have a limited use in industry.

Significance of Intelligence Quotients. By the use of these tests with large groups of children and adults, the distribution of scores shown in Table VI has been obtained. This is assumed to be a normal distribution of the general population. By comparing the I.Q. of any person with these norms, his relative standing can be obtained.

TABLE VI. DISTRIBUTION OF INTELLIGENCE QUOTIENTS

Intelligence Quotient	*Percentage of the Population Making these Scores*	*Classification*
0–69	1.5	Mentally retarded
70–79	4.5	Borderline
80–89	14	Dull
90–109	60	Normal
110–119	14	Bright
120–139	5	Very bright
140 up	1	Genius or near genius

Performance Tests. All the modified forms of the Binet-Simon tests require some knowledge of language and the ability to use it. This fact has always been recognized as a disadvantage, and various attempts have been made to eliminate language in intelligence tests. The greatest advance in this respect has been the development of what are commonly called performance tests. The instructions for these tests are given mostly in pantomime, and the responses of the subject are largely in terms of the manipulation of objects. The tests are of especial value in testing illiterates, persons who do not understand English, the deaf, and those with other handicaps which make the use of language a difficulty.

The advantages which come from the use of performance tests would warrant a wider use of them were it not for the fact that they have never been sufficiently accurate to replace the Binet-Simon tests.

Performance tests in great variety have been used. A great many modifications of block-fitting tests have been developed. Some depend upon the form of the block; others have pictures on the face of the block which furnish additional help in the correct solution. In one block test the subject has to build various patterns from blocks of varied colors. Other tests, more like puzzles, have been used to measure the significance of various types of performance employed in their solution. Others are in the form of mazes through which the person has to thread his way.

The standardization of performance tests has been by the empirical method. A prospective test is given to persons who are known to be bright, as well as to those who are known to be mentally deficient. To have discriminatory value, a test must show a fairly clear distinction between the performances of the persons in these two groups.

Group Tests. Just before and during the World War there was a demand for a test which could be given to large groups of adults at one time. Professor Otis constructed such a test in 1917. In 1918 a group of psychologists was appointed by the American Psychological Association to construct a test for use with army recruits. There were two special needs for such a test: first, to pick out those recruits who had sufficient ability to be trained as officers, and second, to pick out those who were not intelligent enough to perform the ordinary duties of soldiers.

The test which was constructed for the purpose was called Army Alpha. This test consists of eight parts. The first is a test in following directions. The second is a test of simple problems in arithmetic. In another, the subject must tell the best of three possible answers to a question. Another part consists of questions on general information.

Sample Items from Army Alpha

Test 2

Get the answers to these examples as quickly as you can. Use the side of the page to figure on if you need to.

Samples: How many are 5 men and 10 men? Answer (15)
If you walk 4 miles an hour for 3 hours, how far do you walk? Answer (12)

1. How many are 40 guns and 6 guns? Answer (   )
2. If you save $6 a month for 5 months, how much will you save? Answer (   )
3. If 32 men are divided into squads of 8, how many squads will there be? Answer (   )
4. Mike had 11 cigars. He bought 3 more and then smoked 6. How many cigars did he have left? Answer (   )
5. A company advanced 6 miles and retreated 3 miles. How far was it then from its first position? Answer (   )

Test 4

If the two words of a pair mean the same or nearly the same, draw a line under *same*. If they mean opposite or nearly the opposite, draw a line under *opposite*. If you cannot be sure, guess. The two samples are marked as they should be.

Samples: good — bad .... same — <u>opposite</u>
little — small .... <u>same</u> — opposite

1. cold — hot .... same — opposite
2. long — short .... same — opposite
3. bare — naked .... same — opposite
4. joy — happiness .... same — opposite
5. find — lose .... same — opposite

Test 8

Notice the sample sentence: People hear with the EYES EARS NOSE MOUTH

The correct word is *ears* because it makes the truest sentence.

In each of the sentences below, you have four choices for the last word. Only one of them is correct. In each sentence, draw a line under the one of these four words which makes the truest sentence. If you cannot be sure, guess. The two samples are already marked as they should be.

Samples: People hear with the EYES <u>EARS</u> NOSE MOUTH
France is in <u>EUROPE</u> ASIA AFRICA AUSTRALIA

1. America was discovered by DRAKE HUDSON COLUMBUS CABOT
2. Pinochle is played with RACKETS CARDS PINS DICE
3. The most prominent industry of Detroit is AUTOMOBILES BREWING FLOUR PACKING
4. The Wyandotte is a kind of HORSE FOWL CATTLE GRANITE
5. The U. S. School of Army Officers is at ANNAPOLIS WEST POINT NEW HAVEN ITHACA
6. Food products are made by SMITH & WESSON SWIFT & CO. W. L. DOUGLAS B. T. BABBITT
7. Bud Fisher is famous as an ACTOR AUTHOR BASEBALL-PLAYER COMIC-ARTIST
8. The Guernsey is a kind of HORSE GOAT SHEEP COW

9. Marguerite Clark is known as a SUFFRAGIST SINGER MOVIE-ACTRESS WRITER
10. "Hasn't scratched yet" is used in advertising a DUSTER FLOUR BRUSH CLEANSER

In order to test men who were illiterate or unfamiliar with the English language, Army Beta was constructed. Beta consists of a series of drawings and mazes. The directions are given in pantomime. Although not so satisfactory a test as Alpha, this test was used with the foreign-born and the illiterate natives. Equivalent scores were devised whereby the score in one test could be interpreted in terms of the other.

Many other group tests have been devised since the army tests. Some of these which have had the widest usage are the Thorndike tests, the American Council of Education tests, the Otis Self-Administering tests, the Morgan Mental test, and the Scott test. Each has its own special advantage.[1] In certain situations, one is better; in other situations, another test will prove more satisfactory.

LI. The Use of Tests

Tests were originally used primarily to measure the ability of school children as a means of educational guidance, but their use has been extended to measure the ability of applicants for entrance to college and to determine the classification and placement of workers in industry.

Principal Uses of Intelligence Tests. The principal uses that have been made of intelligence tests are:

1. *The classification of children in the schools.* Children may be placed in a certain grade on the basis of an intelligence test. Pintner and Noble classified a whole school in Columbus, Ohio, on the basis of intelligence-test scores. The experiment proved to be an improvement over the traditional

[1] Most of these tests may be obtained from the World Book Co., Yonkers, N. Y., or the Public School Publishing Co., Bloomington, Ill.

methods of promotion. Some children, as the result of the test, were promoted a whole year, while others were demoted. The reclassification not only improved the classroom work, but the deportment as well. The bright child who is kept back often develops habits of idleness, and if he is active, is likely to be a real trouble-maker. The dull child loses interest because much of the material is too difficult for him. He either becomes resigned to his fate, develops into a disturbing element in the school, or uses all his ingenuity in devising ways of getting out of school. To be sure, intelligence is only one factor in school success, but it is without doubt the most important single factor.

Children transferring from one school system to another are sometimes classified upon the basis of intelligence tests, achievement tests, or both. This plan generally proves more satisfactory than accepting grades from another school system or giving an ordinary entrance examination.

The use of intelligence tests may be an aid in discovering the cause of a child's failure in school. There are many causes of failure, but by the use of intelligence tests, we may be able to discover whether or not failure is due to lack of ability.

2. *The selection of students seeking admission to college.* Many private colleges and universities use tests as a basis for selecting entrants. Some state universities make a limited use of tests. It has been found that intelligence-test scores and the high-school records together form the best possible basis for prediction of probable college success or failure. Failure in college is a loss to both the student and the institution. If, by a series of tests, it is possible to predict success or failure, a real service has been performed.

The usual method of determining the value of intelligence tests for selecting prospective college students is to correlate the intelligence-test scores of students already in college with their standings in scholarship. In the many studies of this kind which have been made, the correlation[1] between grades and intelligence-test scores has generally been from 0.35 to 0.60 when valid intelligence tests have been used. These correlation figures give an indication of the value of such tests in predicting college success.

Intelligence-test scores have been used in dividing classes into brighter and slower sections. Large classes are often divided into three sections on the basis of ability. Sometimes the superior students are allowed to take more work and finish college in a shorter time. Sometimes the sections of brighter students are given special assignments. In some colleges, superior students are given special problems upon which they are expected to make original investigations or independent study. These are called honor courses or independent-study courses.

The author has divided a class in general psychology into three quiz sections on the basis of ability and scholarship. The bright group spends the hour in constructive discussion and on new problems. The slow group spends the time in review and drill on fundamentals.

3. *The selection of workers in industry.* Intelligence tests have often been used in the selection of clerical help and the higher types of workers and executives. Many studies have proved the practical use of such tests in selection and promotion.

Differences in the intelligence of men in different vocations were clearly demonstrated by the use of Army Alpha during the World War. The Alpha test was given to 1,750,000 men. In Table VI the scores of men in different occupations are given.

[1] Correlation is a mathematical method of expressing relationship between two sets of scores made by the same individuals. If there is a complete, direct relationship, the correlation is 1.00. If there is no relationship, the correlation is 0. If there is a complete, inverse relationship, the correlation is 1.00.

TABLE VII. AVERAGE SCORES ON ARMY ALPHA TEST MADE BY MEN IN DIFFERENT VOCATIONAL GROUPS

Group	*Low Quarter*	*Average*	*High Quarter*
College Students	111	150	178
Civil Engineers	99	117	143
Bookkeepers	77	101	127
Telegraphers	61	85	110
Telephone Operators	52	70	100
Carpenters	40	60	84
Truck Drivers	37	58	88
Barbers	37	58	83
Farmers	30	48	73
Laborers	28	47	68

The high and low quarters are given for each group. The table is read as follows: The average score for college students was 150 with 50% falling between the scores 111 and 178; the average score for civil engineers was 117 with 50% falling between the scores 99 and 143; etc. The highest possible score on the test is 212.

From this table it is apparent that the amount of ability required in these different occupations varies greatly. It is also probable that the scores in the low quarter indicate about the lowest limit necessary for success in the respective occupations. Practical experience has shown that the college student who cannot make more than 110 on Army Alpha is not likely to succeed in college. There are many exceptions to this rule, but it is about as safe a basis for prediction as we have. Some students who make 110 or below will succeed, and many who make more than 150 will fail; but these exceptions can generally be accounted for by some factor which the test does not measure, such as unusual industry, persistence, insufficient time for study, poor health, and the like. Similarly, not all barbers are so deficient in intelligence that they cannot make more than 83. Neither is it true that a barber who cannot make 37 is necessarily a poor barber. Yet it would hardly be advisable to recommend that anyone making less than 37 try to learn barbering unless he has some good reason for trying. From these statements, it will be noted that these scores are generally indicative of the general ability demanded for the

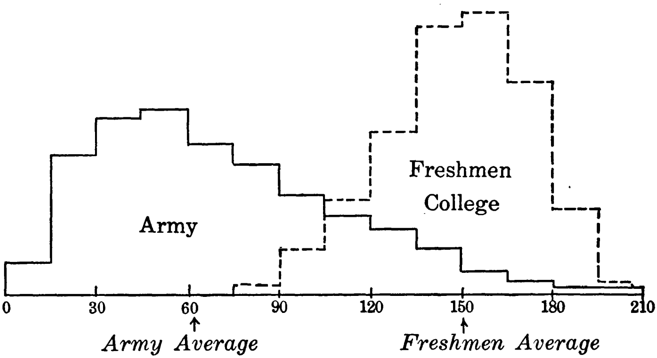

FIG. 57. DISTRIBUTION OF THE SCORES ON ARMY ALPHA OF ARMY RECRUITS AND COLLEGE FRESHMEN

The heights of the columns are proportional to the per cent of the group making the corresponding score on the base line. (From Woodworth, *Psychology*. Henry Holt and Company.)

different occupations. Of course, barbering, like many other occupations, depends upon special skills. These special skills may be more important for success than intelligence. However, a certain amount of intelligence is essential in any occupation.

A graphic comparison of the scores made by army recruits and by college freshmen on Army Alpha is given in Figure 57.

The Relative Value of Tests and Ratings. Scott and Clothier describe the use of tests with several groups of employees. In one company, tests were given to a group of

TABLE VIII. MENTAL TEST SCORES AND SUPERVISORS' RANKINGS

(From Scott and Clothier, *Personnel Management,* by courtesy of McGraw-Hill Book Company.)

Employee	*Test Score*	*Test Ranking*	*Supervisors' Combined Ranking*
A	67	1	2
B	63	2	3.5
C	61	3	5
D	59	4	6
E	54	5	7
F	52	6	1
G	50	7	14
H	50	8	9
I	48	9	3.5
J	47	10	12
K	46	11	15
L	43	12	18
M	41	13	8
N	40	14	16.5
O	37	15	10
P	36	16	13
Q	32	17	11
R	23	18	16.5
S	15	19	19

This table shows a comparison of mental alertness scores, ranking in the test, and the supervisors' rankings in "general value" for nineteen employees in a study of a typical industry employing women stenographers, typists, and clerks.

women stenographers, typists, and clerks. These same employees were rated for "general value" by two supervisors. Table VIII gives the test scores (Scott Mental Alertness Test), the test ranking, and the combined ratings of the supervisors.

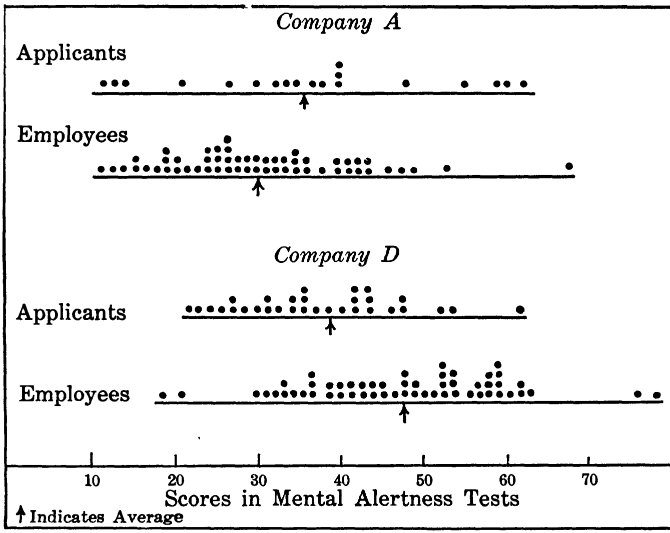

FIG. 58. COMPARISON OF TEST SCORES OF APPLICANTS WITH THOSE OF EMPLOYEES FOR TWO DIFFERENT COMPANIES

(From Scott and Clothier, *Personnel Management,* by courtesy of McGraw-Hill Book Company.)

While there is not a perfect correlation between the ranking by the test and by the supervisors, there is a large amount of agreement between them. In only two cases — employees G and M — were the rankings widely different. Other similar results have been secured by these and other investigators.

Scott and Clothier also compared the test scores of the women clerical employees of two different companies with the scores made by applicants for positions with these companies. Figure 58 presents the results of this study. In this figure, each dot represents a person's score on the test. The rejected applicants for positions with the two companies are of about equal ability. However, in Company A most of the women with low scores are retained, while those with high scores tend to withdraw. In Company D, many of the applicants with low scores are not employed. Furthermore, women with high scores tend to remain with the company.

Which company is making the better selection and retaining the better type of employees? We are probably tempted to say that Company D is doing better. This is true if the type of work that these companies are doing requires a high degree of intelligence. On the other hand, if the work can be done efficiently by women with a lower degree of intelligence, Company A is doing better. We can answer this question only after a study of the type of work that these employees are doing and a study of the relative efficiency of the two groups. When we have determined the degree of mental ability required for a job, we can use intelligence tests to aid in selecting applicants with that amount of ability.

It is just as important in many cases to determine the upper limits of intelligence needed for a job as to determine the lower limits. Dr. Snow found that men with intelligence above a certain level, although they might make good cab-drivers, did not stay at their jobs long enough to make it profitable to employ them. He therefore set a maximum score as well as a minimum score, and hired only those making a score somewhere between these limits. Dr. Kenagy made a similar discovery in a study of salesmen. The only difference between these two studies was the fact that a higher degree of intelligence was required for the salesmen.

Scott and Clothier report another study which shows a comparison of the ratings of employees made by different mana-

TABLE IX. TEST SCORES AND MANAGERS' RANKINGS COMPARED
(From Scott and Clothier, *Personnel Management,* McGraw-Hill Co.)

Name	*Test Rank*	*Firm Rank*	*Manager I*	*Manager II*	*Manager III*	*Manager IV*	*Manager V*	*Manager VI*
A	1	10	6	5	13	9	12	12
B	2	1	1	..	..	2	..	3
C	3	2	2	9	1	11	..	1
D	4	5	11	3	7	3	15	5
E	5	9	13	..	..	...	10	10
F	6	3	4	6	..	20	2	2
G	7	4	4	1	3	6	6	..
H	8	14	14	..	15	26	20	6
I	9	12	9	13	25	5	8	16
J	10	8	10	..	..	..	3	14
K	11	15	15	20	..	14	25	8
L	12	7	8	15	9	8	1	15
M	13	6	5	8	5	15	5	13
N	14	13	12	18	..	..	9	18
O	15	16	16	..	..	..	11	19
P	16	20	27	23	21	..	14	9
Q	17	23	20	16	19	23	27	26
R	18	22	19	28	..	27	22	17
S	19	21	23	21	17	..	18	24
T	20	26	25	..	..	..	16	25
U	21	18	18	..	..	..	24	11
V	22	17	17	26	..	..	4	..
W	23	19	..	..	27	17	13	22
X	24	24	26	..	23	18	17	23
Y	25	25	22	24	..	21	23	27
Z	26	11	..	11	11	12	19	4
AA	27	27	24	..	28	24	26	28
BB	28	28	28	..	..	..	28	20

Coefficients of Correlation

Tests		.825	.850	.736	.633	.582	.535	.674
Firm Rank			.951	.844	.879	.689	.730	.802
Man. I				.786	.814	.598	.725	.663
Man. II					.691	.627	.353	.611
Man. III						.490	.438	.706
Man. IV							.577	.493
Man. V								.320
II, III, IV, V	.768		.886					

gers, the ratings these employees made of each other, and the intelligence-test scores of the persons rated. From Table IX we see that the test rank of employee A was 1; the combined ratings of the managers gave him rank 10. However, Manager I ranked this man 6, and Manager II ranked him 5. While there are discrepancies like this between the rankings, there is considerable general agreement between the test scores and the managers' rankings. There is also general agreement between the rankings given by the different managers.

The list of correlations given at the bottom of the table provides a means of evaluating the rating ability of the different managers. For example, the rankings of Managers IV and V correlated lower with both test scores and the ranking of the other managers than any of the others. This is not final proof, but it is strong evidence that they are not so good raters, for example, as Manager I.

Ratings like those obtained by Scott and Clothier may be obtained under favorable rating conditions. On the other hand, when care is not exercised or when other conditions for successful rating are not fulfilled, results like those cited by Professor Hollingworth are likely to be obtained. The usual care was exercised by Hollingworth in obtaining ratings by twelve sales-managers on 57 applicants after a personal interview of each applicant by each sales-manager. Ten ratings selected at random are presented in Table X.

This lack of agreement between ratings by different supervisors presents a serious difficulty. Many different types of methods have been devised for rating intelligence, personality traits, and professional qualifications. Such schemes, when well devised and administered, give a great deal of valuable information. But they must be carefully devised and administered.

TABLE X. DISCREPANCY IN THE RATINGS OF TEN APPLICANTS FOR POSITIONS BY TWELVE SALES-MANAGERS

(From Hollingworth, *Judging Human Character,* by courtesy of D. Appleton and Company)

Applicants	*Sales-Managers*											
	1	2	3	4	5	6	7	8	9	10	11	12
A	33	46	6	56	26	32	12	38	23	22	22	9
B	36	50	43	17	51	47	38	20	38	55	39	9
C	53	10	6	21	16	9	20	2	57	28	1	26
D	44	25	13	48	7	8	43	11	17	12	20	9
E	54	41	33	19	28	48	8	10	56	8	19	26
F	18	13	13	8	11	15	15	31	32	18	25	9
G	33	2	13	16	28	46	19	32	55	4	16	9
H	13	40	6	24	51	49	10	52	54	29	21	53
I	2	36	6	23	11	7	23	17	6	5	6	9
J	43	11	13	11	37	40	36	46	25	15	29	1

From these results, it can be seen that applicant A, for example, was rated 6 by one sales-manager and 56 by another. That is, one man placed only five applicants out of the 57 higher than applicant A, and the other placed only one lower. The ratings of other applicants show similar variations in opinion. Hollingworth says of these ratings:

When it is borne in mind that these judges were not casual people who were enlisted in the investigation, but expert sales-managers, experienced interviewers, and directors of personnel, and that the position (salesmanship) for which they were rating the applicants was precisely in the line of work in which they had developed expertness and acquired positions of responsibility, the inference is clear.

However much the interview may be improved by better methods of inquiry and report, in its traditional form, it is highly unreliable.[1]

Professor Rugg says there must be at least three raters, each of whom must know the men they are rating. These men must know how to rate. If they give all high ratings or all low ratings, the ratings are worthless. Good employees must be rated high and poor employees rated low. Furthermore, the raters must have clearly in mind the traits to be rated. Too often we find what is called the *halo effect;* that is, the rater has a general opinion of the person he is rating. This opinion may be either good or bad. Because of this general opinion, he is likely to rate the employee high or low in all the traits. Each trait must be considered separately. A man may be high in one trait and low in another. If all these conditions are not met, the ratings may be worse than useless; they may give wrong conclusions.

We have gone into some detail in discussing ratings because too often we have nothing better than ratings with which to compare test scores. It may be fair to assume that sometimes the test scores are more reliable than the ratings with which they are compared. Ratings have their values and sometimes we have nothing better, but wherever possible, we should use some more reliable measure of ability. Scholarship, grades, or output records, where available, constitute better checks with which to compare our test scores.

Limitations of Intelligence Tests. There are three main reasons why intelligence tests do not predict with absolute certainty success in school or industry.

1. *The tests themselves are not perfect measures of intelligence as such.* As yet, the best tests only approximate a perfect measure. It is probable that a test can never be con-

[1] Hollingworth, H. L., *Judging Human Character*, p. 66. Appleton, 1922.

structed which will be as accurate a measure of intelligence as our physical measurements are in their respective fields. But by improved technique in test construction and validation, such a goal is being gradually approached. The better tests of the present time are near enough to this standard to make their use desirable.

2. *In most types of work there are factors other than intelligence necessary for success.* For example, the most intelligent man in any group may not be a good carpenter, even though he has much more intelligence than the best carpenter. Furthermore, although he has more intelligence than an average man, he may not be able to learn to be a good carpenter. Carpentry may require certain types of ability and certain specific training which are somewhat independent of intelligence.

3. *Other traits of personality besides intelligence are necessary for success.* A man may have more than the requisite intelligence to sell insurance, but not have sufficient sociability and aggressiveness to meet prospective buyers. A man may have the ability to sell questionable stocks, but his moral standards may be so high that they prevent him from engaging in such an occupation.

Yet, with all these limitations, it must be borne in mind that we must use some method of selection. Hollingworth [1] has shown us the fallacy of placing too much credence in the use of letters of application, photographs, or personal interviews. While no method is perfect, in some circumstances intelligence-test scores are of distinct value.

Use of Intelligence Tests in Vocational Guidance. Another use of intelligence tests is in vocational and educational guidance. Many factors must be taken into consideration in the guidance and training of young people. Among these are: (1) native capacity, which we have already considered in re-

[1] Hollingworth, H. L., *Judging Human Character,* Chapters 1–6. Appleton, 1922.

lation to school work; (2) the amount of work or the quality of work done by the student; (3) the kind of training he should receive in preparation for his life work. From what has already been said, it is apparent that a child should not be induced, or even permitted, to go into a type of work for which he does not have the capacity necessary for success. Intelligence-test scores, therefore, should aid the counsellor in giving advice to children and young people concerning the selection of both their courses and their life work. While test scores should never be considered as complete measures of ability, they are the best single source of information available, and should be seriously considered in all educational and vocational guidance.

Tests of Capacities Other Than Intelligence. The decided success that has attended the use of measures of intelligence has stimulated the attempt to devise tests to measure other capacities and personality traits. None of these has approached the stage of perfection reached by the intelligence tests, but they are of value if used with some critical insight as to their limitations.

1. *Tests of mechanical ability.* Of the factors other than intelligence which make for success or failure in industry, one of the most important is mechanical ability. There is a wide range of individual differences in mechanical aptitude. Training is a large factor in mechanical work, but even with the best training some persons lack the capacity to learn such things.

Professor Stenquist has constructed a test for measuring general mechanical ability. His test consists of ten mechanical devices which have been disassembled. The subject is allowed thirty minutes to put as many of the articles together as he can. There is a set of simple articles for children, and a set of more difficult ones for adults. Standard scores are available for different ages. The test has been used in the schools to determine which students could profitably take courses in shop work and mechanical training. It has also been used in industry to select those who are most likely to succeed in mechanical work.

2. *Tests of musical ability.* Some persons possess the ability to sing or play some musical instrument. On the other hand, there are persons who can practice a lifetime and never become proficient in music. Professor Seashore has constructed a test for the measurement of musical ability. This test consists of a series of five phonograph records. These records are constructed to measure: (1) pitch discrimination, (2) intensity, (3) rhythm, (4) consonance, and (5) tonal memory. While no very careful study has been made to show just how prognostic these tests are, they do seem to give considerable indication of musical ability.

3. *Tests of various skills.* Executives, teachers, and others who must render some estimate of the achievement of persons under their supervision have always used tests of skill. The instructor constructs examinations and uses them to grade his pupils. The employer keeps records of the speed and accuracy with which his stenographer, his pressman, his lathe hands, and others work. Salesmen keep efficiency records.

In most instances these tests and records are not standardized. They depend upon the whims of the examiner or the employer. Those who must keep records of their employees would do well to adopt the empirical method which psychologists have found so valuable in the construction of intelligence tests. That is, they should give their test to many persons of known worth, and from the results set up their standards.

Interest and Ability. By the use of prognostic tests it is possible within certain limits to tell what capacities a person possesses. Such information gives a clue to the type of work a person is capable of doing. Aptitude tests indicate the ability possessed by an individual as a result of training and practice. There is one other factor of importance in determining the type of work which a person will do best — namely, interest. Any attempt at a selection of a life work which does not take interest into account is very likely to fail. Many a fond parent determines for the child what occupation he is to enter when he grows up. The parent may even consider the capacities of the child and send him to the kind of school which will prepare him for that work. But if the child's interests are not taken into account, the plans are likely to fail.

Several studies have been made to determine the relationship between interest and capacity. Does interest in any type of work indicate a probable capacity for that type of work? The evidence from these studies is conflicting. Some of the results tend to indicate that there is a relationship between interest and ability, and some seem to prove that there is none. It is true, however, that in certain types of work a person with mediocre ability, but great interest, may succeed by sheer application. Therefore, it is probably best to determine the trend of the interests and the nature of the ability and then, from these facts, to direct the training toward a type of work in which the ability and interests merge.

In the next chapter, we shall consider the social factors which determine the relation and standing of the individual with respect to the group. Any consideration which fails to take these social factors into account is inadequate. Man is primarily a social being, and the social phase of his life must be considered in any survey of his capacities and capabilities.

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CHAPTER XII

PERSONALITY

LII. Outline of Some Personality Characteristics

Personality is that part of an individual that distinguishes him from everybody else. When we say that a man gets on well with his superiors, is coöperative, energetic, ambitious, but honest and truthful, we are trying to describe his personality. The problem of describing the personality of one individual and differentiating that individual from all others presents a serious problem in psychology.

Definition of Personality. We shall define personality as that group of complex behavior patterns and attitudes which differentiate one individual from another. Man affects his fellowmen in many different ways. He may associate with people or withdraw from them; he may lead them or he may be led by them; he may dominate others or be dominated. Such constitute factors or elements in personality as the term is here used.

Personality has been defined in other ways. Ministers have used the term to indicate what they consider the divine part of man. Many have used the term as equivalent to *self*. We are making the distinction that self refers to the whole individual, both social and nonsocial in character. William James used the word *self* in this broader sense, meaning by it both what he called " the knower " and " the known." In contrast with the self as used by James we are using the word personality as synonymous with what he called the social self.

Personality is often confused with character. We should confine the latter term to those types of social behavior and those social attitudes which are involved in the problems of right and wrong; that is, those factors which are socially approved or disapproved.

As thus defined we see the great importance of personality in our analysis of the individual. Certainly the large part of an individual's life is concerned with his social relations. Before man lived in large, highly organized groups, personality factors were not so vital, but as he became civilized and began to live in thickly settled communities, social relationships became more important. A give-and-take attitude developed between people; men learned how to live together; leaders came to the front; governments were established; and industry was developed. Man had become essentially a social being.

In modern society even the day laborer, relatively simple though his social contacts may be, cannot live apart from his fellows. As man progresses in the economic scale, his success becomes more and more dependent upon his social relations. In the highest forms of modern society man holds his economic position primarily on the basis of his personality.

A Classification of Personality Traits. Many attempts have been made to analyze personality. Some lists of the elements or traits of personality are very elaborate, one rather well known list containing more than a hundred items. Other lists are very brief; for example, one contains only three traits. There are all sorts of variations between these extremes.

Manifestly personality is very complex, and any complete analysis would be likely to contain numerous items. On the other hand, any very elaborate classification defeats its main purpose — that of differentiating one social being from another. Any extended list of traits possesses a double disadvantage: first, an almost unavoidable overlapping of the meanings of the items included in such a list; and second, the difficulty of rating or measuring even one person in a large number of traits, and the greater difficulty of comparing large numbers of persons with others.

There are, therefore, at least several practical reasons for limiting the number of traits to six. We propose the following list of traits by which it is possible to differentiate one person from another: (1) personal appearance, (2) social intelligence, (3) sociability, (4) aggressiveness, (5) emotionality, and (6) morality.

1. *Personal appearance.* In physical appearance men vary widely enough that one seldom mistakes one person for another. Two individuals may appear to be very similar, yet when examined as to height, weight, color of skin, facial features, and health, they will be found very different indeed. Additional differences may be noted in dress and features of personal hygiene. All these factors form the complex which we call personal appearance. For this discussion, physical differences are not significant in themselves but only as determining the attitude which one person has toward another. If the combination of the physical features in a person's make-up is such as to impress others favorably, the person is said to have a pleasing personal appearance. If some unfavorable element is strong or if the combination of elements is not favorable, the person is said to have a displeasing personality.

Personal appearance may contribute to or detract from success, especially in positions where social relations are important. It is probably the most important single factor in the selection of strangers for responsible positions. It is certainly most important for salesmen and private secretaries. The writer remembers that a board of education in one of our large cities once selected as superintendent of schools a man of excellent personal appearance, though he was a stranger to all of them and they had investigated his record only superficially. A pleasing personal appearance won the position, with no question as to other factors which might affect his success. In industry such occurrences are not at all uncommon.

One reason for placing so much dependence upon personal appearance is to be found in the popular belief that we can judge the real worth of a man at sight. When a person presents a good appearance this is usually, but often fallaciously, taken as an indication of the fitness of the individual for any line of endeavor. In concluding this discussion, it is hardly necessary to say that too much importance has generally been attached to this one trait in contrast with others which may be equally or even more significant for success.

2. *Social intelligence.* Intelligence is another trait of importance in social relations. This trait has been discussed in Chapter XI, but our approach here is somewhat narrower than in the preceding chapter. There we described intelligence as the capacity to adapt to life problems. Intelligence as a factor in personality includes only those elements which are social in nature. It is true that our intelligence, when expressed in any form, affects our social relations at least indirectly. For example, if our intelligence is expressed in the form of making money, it affects our social position as well as our position for control of those under us. Although such expressions of intelligence affect our personality indirectly, we are here restricting the term social intelligence more specifically to intelligence as it is exhibited in our control of other people. Some men are very adept in such control and others seem most unintelligent, but the majority of mankind is mediocre in this respect. It goes without saying that those who are high in general intelligence are not necessarily high in social intelligence. It is also true that some who are not especially superior in general intelligence may be very skillful in handling men.

The importance of social intelligence in industry is clearly apparent. This trait should greatly outweigh other personal factors in the selection of men for managerial and executive positions. Many a man of the most unprepossessing personal appearance can direct or control large enterprises. Intelligence is much more important than mere appearance. Of course, the truly great executive possesses both general and social intelligence. If he does not, he must surround himself with persons possessing the type of ability which he lacks. The intellectual type of man can associate himself with some one who can control men. On the other hand, the executive leader can secure the assistance of experts in the fields in which he needs expert advice.

3. *Sociability*. A third element in personality is the manner and degree of adaptation of the individual to the social group. Some men always make themselves a part of any social group. If unable to act and think with the group, they conform to the standards of those with whom they are associated. "When in Rome, do as the Romans do" is the rule for any such man, who, though he tends to seek the group with which he is in sympathy, nevertheless is a conformist so far as it is at all possible. Such a person is the typical "good mixer." The opposite in type is not interested in people to the point of sharing in their joys and sorrows; he tends to withdraw from the group; he is an individualist. The two types described represent the extremes between which most men are found.

At first thought sociability may not appear greatly different from social intelligence. The difference is that the socially intelligent individual may be a good director of people and groups but not a part of the group. Many a successful executive directs but holds himself aloof from the people whom he governs. Another man becomes attached to the group, and, whether or not he is the leader, he is sociable. In so far as the latter leads his group he is both socially intelligent and sociable.

Professor Jung, an Austrian psychologist, has classified men as introverts and extroverts. The introvert is the reflective, self-centered type of individual. The extrovert is the energetic, active type and is interested in things outside himself. This is an important classification of differences between persons. While there is no inherent virtue in either introvertive or extrovertive tendencies, they tend to indicate two quite different attitudes toward life. We expect the responses of the extrovert to be characteristically different from those of the introvert. The introvert is egoistic and judges things in relation to himself; the extrovert is externally minded and is particularly suited to salesmanship.

Extroversion, while somewhat related to sociability, is different in many respects. Extroversion is essentially a matter of attitude while sociability is essentially a matter of behavior. Not all extroverts are sociable and not all introverts are unsociable. The writer is well acquainted with a teacher who is extremely introvertive, yet she is unusually sociable. Her sociability is a compensation which she has made in order to adapt herself better to her station in life. While the extrovert is the typical salesman type, many an introvert makes a good salesman. He can do so by the same type of compensation mentioned above. To the introvert selling is an intellectual problem with few or no emotional appeals either to himself or to his customers.

4. *Aggressiveness.* Another fundamental aspect of our relations toward others is the forcefulness with which we exert our ideas and wishes upon others. Some men dominate any social situation in which they are placed. We often say that such a person is strong willed. In contrast with such persons, some men are submissive, willing to be led. All reformers and politicians are aggressive. Alexander, Charlemagne, Robespierre, and Washington were aggressive. The same general characteristics hold true in the industrial world. We find the aggressive, dominating types in positions of authority; we find submissive types as research workers, inventors, experts in their various fields. The workman is likely to be submissive,

whether naturally inclined to be so or not; if he is not, he is likely to be in trouble. Professional men may be either aggressive or submissive; more often they are neither one nor the other to any marked degree.

Like most of the other traits of personality, there is no virtue in being especially aggressive or especially submissive. Modern politics and industry give certain advantages to the aggressive individual, but this is probably a criticism of modern civilization. Many truly great and lovable men are meek rather than dominating. The lesson in the Beatitudes in regard to meekness is worth trying. Yet meekness does not mean unquestioned servitude.

5. *Emotionality.* Another method of adjusting to one's environment is through the emotions. One person is highly emotional — that is, easily agitated and very excitable; another is calm and deliberate in any situation. The highly emotional, and consequently unstable, individual is likely to lose control of himself when unusual or undesirable situations arise. Any normal person may be so affected when the strain becomes too great, but the highly emotional individual will succumb at the least provocation. Thus, the degree of emotionality which one develops may become a highly important factor in his personality.

Excitability, when extreme, is a serious handicap in certain types of work. The excitable teacher is likely to be an inefficient teacher; and the doctor and surgeon can least of all afford to be excitable. People who are in positions of great physical danger must be able to keep cool and calm. In some types of work an ordinary degree of excitability is not a handicap. Some very good executives are excitable and occasionally lose control of themselves. If this does not occur too often, it may prove no handicap and sometimes be a real advantage. There is a popular notion that the artist or the writer tends to be highly emotional and that such a state is conducive to the best work. There seems to be no experimental evidence to support this theory. Perhaps, as some one has said, the idea has been generally accepted, and the artist or writer finds it a convenient reputation to sustain.

6. *Morality.* The last of the personality traits to be discussed is that of our relations to the traditions, customs, and ideals of the group. We here refer only to the social aspect of this trait and not to the broader ethical and religious phases of the problem of right and wrong. It is closely related to character. There are certain ideas of right and wrong which are held by the group to which we belong. Only so long as we adhere to these in our actions are we approved by our society; to be unconventional is to be ostracized.

It is true that things which are approved in one generation may be disapproved in another. At one time it was not considered wrong to steal from another tribe [1]; and not so long ago slavery was accepted and approved by at least half of the so-called civilized world. It is also true that the same things may not be approved by different groups in the same age. A rather extreme example is the difference between the standards of the Maffia gangs and those of the Boy Scouts. Despite these differences, there is a large group of customs, traditions, and ideals which are generally accepted by the great masses of society. Conformity to these standards constitutes morality in the sense in which we are using the term.

Other Personality Traits. There are many other traits of personality which we have not mentioned here. The long lists of adjectives used in personal descriptions give clues to what some of these may be. Coöperative, ambitious, selfish, brave, cheerful, optimistic, honest, truthful, industrious, reliable, tactful, courageous, and persevering are a few such

[1] It is not to be inferred that such practices do not still go on. When disguised as "nationalism" they may be permitted and even sanctioned by the social group.

terms. Some of these terms are similar to the traits mentioned above; others are composed of two or more of these traits. As already stated, our list of six traits is not proposed as a complete list. Instead we have chosen these six as mutually exclusive and independently variable. Furthermore, it is believed that this list can be used to differentiate rather definitely one individual from another.

Uses of Personality Analyses. There are three main purposes for which an analysis of personality may be used. It may be made the basis of (1) a person's analysis of his own social qualities, (2) a personal evaluation of others, (3) the group opinion of the social qualities of any person or group of persons.

The first two of these are individual in character and, like other introspective methods, are very difficult, if not impossible, to evaluate statistically. Nevertheless they have a value which should not be belittled. Each of us should take stock of his social assets and liabilities at times. While one's estimate of himself is a mere opinion and is subject to overrating on items which he considers favorable and to underrating on unfavorable traits, as Hollingworth [1] has shown, yet it at least recalls to his mind the elements which go to make up his personality. By calling attention to these traits he may find reasons for a fairer evaluation of himself. Whenever he finds traits he desires to modify, he has made the first step necessary to a change. A man who decides that he wants to become more sociable can begin to mix with people. If people do not like him, he may find why they do not and set about to make himself more likeable. His first efforts in this direction may be feeble or even entirely unsuccessful, but generally, if he keeps at it, he will succeed in some degree. Other traits may also be changed. While facial expression is not easily modified, personal appearance, as we have already said, is so

[1] Hollingworth, H. L., *Judging Human Character.* Appleton, 1922.

much dependent on dress, personal hygiene, and certain attitudes that for all practical purposes we may say that personal appearance can be changed.

We may get the impression that a high ranking on each of the traits is desirable. This is not necessarily true. There is no inherent virtue in being sociable or aggressive. Most persons desire to present a good personal appearance, to be socially intelligent, and to be moral. In the sense in which we are using the term, however, the reformer often does not desire to be moral; he believes that his principles are above those of the group. Emotionality is objectionable when it is extreme, yet many, if not most persons, would scarcely wish to be thought cold and unfeeling.

Another use that can be made of personality analyses is in our evaluation of others. We are continually forming opinions of others. These opinions, so long as they are individual, may not have much basis in fact; nevertheless, the opinion of a person in a position of responsibility is important both to the person holding the opinion and to the person evaluated.

The analysis of personality into traits or elements makes possible and tends to compel a more exact basis of evaluation. There is too often the tendency to form a general opinion of a person, either favorable or unfavorable, and let that opinion dominate our whole attitude toward the person. An individual who is considered for some position may have some favorable traits and others less desirable. We should consider both and weigh the one against the other as a basis for our judgment of the person's fitness in any line of endeavor.

The whole program of educational and vocational guidance, as well as the selection and promotion of employees in industry, rests upon the analysis of personality. Scientific guidance awaits further progress in such analyses. Until such time arrives we must do the best we can in estimating what each person is best fitted to do.

LIII. Methods of Measuring Personality

Many attempts have been made to measure personality. In addition to older methods and to the really scientific attempts to solve this problem, there have been many short-cut methods proposed.

Pseudo-scientific Methods. One of the oldest attempts to measure personality is *astrology.* The ancients believed that the stars had something to do with the destiny of an individual. They therefore made careful observations of the star under which a person was born. Modern knowledge of astronomy and biology should completely overthrow such doctrines. Yet we find many persons consulting the almanac in order to foretell the future. At least one large radio station daily broadcasts a horoscope for those born on that day. Even some industrial organizations still use astrology as a method of selecting men. It hardly seems necessary to present arguments against astrology to the readers of this text.

Other more modern methods which have been and still are being used in some places are *phrenology* and *physiognomy.* Physiognomy relates only to a study of the face, while phrenology is concerned with the whole head; but the two methods are essentially the same. Each claims that personal qualities can be inferred from such features as the shape of the head or face. Phrenology was originally founded upon the idea that any functional part of the brain which was well developed would show this development by protuberances on the exterior of the skull.

There is just enough basis of fact in this theory to make it plausible. There is some truth in the theory which gives specific localization to certain functions in definite parts of the brain. Certain parts of the brain, as pointed out in Chapter II, have control over certain bodily functions. Since these areas control these responses, why not infer that well-developed areas indicate exceptional ability? Large muscles indicate strength; why not infer that large brains indicate strong mental traits? The answers to these questions are not hard to find.

The extreme difference between any functional part of the brain and the same area which is not functional is about one millimeter. For example, if the function of an area of one hemisphere is destroyed or if the part is congenitally defective, such an area is likely to be about one millimeter less in thickness than the corresponding area in the opposite hemisphere. Even if such a difference in thickness exists, no appreciable pressure would be exerted on the skull at the point of greater thickness because of the jellylike structure of the brain, and no bulge or protuberance would show on the outside of the head. Furthermore, there may be some protuberance on the outside with no corresponding enlargement on the inside. We can never be sure about what is on the inside of a skull by examining the outside. Many studies have been made comparing the total size of the brain with mental ability. The results show clearly that either too large or too small a brain is likely to be indicative of a low degree of intelligence. Although there are many individual exceptions, more superior men have brains of average size, weighing about 1500 grams, than have either large or small brains.

More recently a study of the endocrine glands has given some basis for the *endocrinological theory* of personality. We know, for example, that the thyroid gland has a certain control over the supply of fat in the body and the growth of hair and that it affects the rate of body metabolism. There are also some mental accompaniments of thyroid deficiency or excess. Some of the other glands function in a similar manner.

Why not infer, then, that from the physical form we can assume the presence or absence of the various endocrine secretions in different amounts? Then we can predict from these facts the mental traits which the presence of these secretions in larger or smaller amounts will produce.

Dr. Louis Berman [1] has advocated such a point of view. After describing the principal endocrine glands and their functions, he analyzes typical personalities caused by excess or deficiency of the various endocrine gland secretions. Berman cites certain cases from history (such as Napoleon) who, he contends, must have been what they were because of their endocrine secretions. Convincing as some of these discussions are, we should be very critical of any extravagant claims for endocrinological explanations of personality traits.

Dr. Kretchmer,[2] a German psychologist, has described three physical types: the asthenic, the athletic, and the pyknic. Each of these types he describes in great detail, attempting to show the correlation between the physical and mental traits. He even goes so far as to name the prevailing types of insanity to which each type is predisposed.

A most convincing argument against any of the pseudo-scientific methods is based upon a study conducted by Professors F. B. Knight and U. V. Cleeton, and upon another by Professor William Sheldon, in which they made careful anthropometric measurements of a large group of fraternity men and compared their results with the estimates the fraternity men made of each other. The experimenters found no relationship between these estimates and any of the physiognomic systems studied.

Because of these and other scientific studies, reputable psychologists are convinced that physical form, other than that resulting from dissipation and the like, can give us little

[1] Berman, L. M., *Glands Regulating Personality*. Macmillan, 1928.
[2] Kretchmer, E., *Physique and Character*. Harcourt Brace, 1925.

or no indication of the accompanying personality traits. We must look to some other method for the analysis of character.

Rating Methods. Rating is a method of measuring personality traits which has been more or less successful. The general principles of rating were discussed in the preceding chapter. It was pointed out that, in order to be successful, there should be at least three independent raters. Each must know how to rate, and each must be familiar with the traits to be rated and with the individuals they are to rate. Another precaution which must be observed in the rating of personality traits relates to the choice of traits to be rated. Too often ratings have been made upon unimportant or ambiguous traits. The traits to be rated must be well defined and mutually exclusive. Various methods of rating have been used. These vary all the way from a series of questions which permit the rater to use his own terminology in answering them to tests composed of questions on personality characteristics. Methods like the first are subjective and the results are likely to vary greatly with the raters. More recently graphic methods of rating have been used. Figure 59 is an illustration of such a graphic rating scale.

Another method which may be classed either as a rating method or a test consists of a series of questions with a graded series of answers to each. The person taking the test is directed to check the best answer to each of the questions. Standard scores are worked out for each question.

As we have said, such methods are often called tests. The line of demarcation between a rating method and a test is not clear. Rating methods may use test questions and tests may use rating methods for securing responses.

Objective Tests of Personality. There is another method of measuring personality which has received much attention within the last few years. We refer to the use of standardized tests. The first personality trait to be measured by tests was

RATING SCALE OF FURTHERANCE-HINDRANCE FACTORS AFFECTING SCHOLASTIC ACHIEVEMENT BY D. T. HOWARD

Indicate your rating in each factor by placing a check on the line where you think it ought to be.

FACTORS					
I. Consider your health as affecting your studies: Is your health always good and conducive to vigorous study, or does it interfere with your work?	Excellent health, sound and vigorous.	My health is better than average.	Not especially good nor bad.	I have some cause to complain of my health.	Bad health is a serious handicap to me.
II. Is the place, or places, where you do your studying ideal for the purpose, or are you distracted or interrupted to an annoying degree? Are you well satisfied, do you think that you are fairly well placed, or have you a great deal of distraction to contend with?	Ideal.	Generally favorable.	Tolerable.	Rather unsatisfactory.	Highly distracting.
III. Do campus activities contribute to your success as a student, or do they engage your time and interest in such a way as to interfere seriously with your studying?	I consider my program ideal.	Rather good than bad.	Neither very helpful nor very harmful.	My studies suffer some.	Very distracting and injurious to college work.
IV. Are you able to arrange your time so as to provide regular hours for study? Or are you prevented from keeping to a regular schedule because of conflicts with duties and engagements that cannot be avoided?	My program can be arranged as I please.	I can always arrange for studies by giving some thought to my program.	Other matters interfere frequently to prevent me from keeping to a regular schedule of study hours.	I find it very difficult to provide study hours.	

V. Do not answer this question unless you do some work to support yourself while in college. If you work for support, does this activity promote the keenness of your scholarship, or does it operate as a serious distraction? Try to express, in terms of benefit or hindrance, the influence of such work upon your studies.	It is ideal and fits in excellently	It is a help to me in my studies.	It makes no difference in my work.	It is annoying.	An extreme distraction and great handicap.
VI. Consider your future career and prospects. Is your general state of mind regarding your future quite unsettled so that you are restless and unable to settle down to systematic study? Or is the exact contrary the case? Or are you indifferent to such considerations?	So disposed that future prospects are a strong incentive to study.	Future prospects a help rather than a hindrance.	Indifferent to such considerations.	Could do better if I had a more settled program.	Very unsettled, and find it hard to get down to study.
VII. Do you find yourself doubtful, for any reason, as to the value of your college studies? Or are you certain that they have a very high value? In this connection consider whether your present studies have or have not an important bearing on your future life and work.	I place the highest value on my studies.	Quite valuable and should be taken seriously.	At least as valuable as any other activity in which I engage.	Other campus activities are more important.	Distinctly minor importance.
VIII. Do you find yourself unable to study by reason of worry, anxiety, or excessive dissatisfaction produced by causes over which you have no direct control? Or is your state of mind generally untroubled and favorable to study?	My mind is free from worries that would interfere with study.	Although I have occasional worries, these do not seriously affect my studies.	I have real troubles at times, but cannot say that they seriously hinder my studies.	I could do better work if I had less to distract my mind.	Worries are a source of real distraction to me.

FIG. 59. AN EXAMPLE OF A GRAPHIC RATING SCALE

intelligence. While we have made a distinction between intelligence as a factor in personality and as the ability to meet and solve life's situations, the two are closely related. Therefore, the results of any test which measures one are indicative of the other. Yet there is probably the need of a test which measures exclusively the social phases of intelligence.

Since the development of intelligence tests, the technique used in their construction has been extended to many other personality traits. We now have tests for everything from personal beauty to morality. Indeed the number of tests is so large that even a list of them makes a rather extensive monograph.[1] It is difficult to classify these tests. Many of them do not fit into the classification given in the earlier part of this chapter, or into any other classification. Nevertheless we shall give examples of a few tests illustrating the measurement of some of these traits.

1. *Introversion-extroversion.* Many tests have been made for measuring introversion and extroversion. The Colgate Mental Hygiene test is probably the best known of these. More recently Kohlstedt, working under the direction of Professor J. J. B. Morgan, has constructed a test for measuring these traits. In this test introversion is defined as that tendency which, in the extreme, may lead to dementia praecox. Extroversion is defined as that tendency which, in the extreme, may lead to manic-depressive insanity. The test contains more than one hundred items concerning which the subject reports his likes and dislikes. The items of the test are concrete situations which are found to differentiate the two groups. In fact, it differentiates them so well that when the test was used alone, in only two cases out of

[1] See bibliographies by Grace Manson, *A Bibliography of the Analysis and Measurement of Human Personality up to 1926*, National Research Council, Washington, D. C.; and M. A. May, *Psychological Bulletin*, July, 1926.

two hundred were the results at variance with a diagnosis previously made by a psychiatrist. A few sample statements from the Northwestern University Introversion-Extroversion test, as the revised form of this test is now called, are appended.

SAMPLE STATEMENTS FROM THE NORTHWESTERN UNIVERSITY INTROVERSION-EXTROVERSION TEST

Yes No I always think things over before acting.
Yes No I would usually rather hear or read something exciting than have it happen to me.
Yes No I like work that requires some attention to little details.
Yes No I am more of a talker than most people.
Yes No Most of my friends think very differently from me about things.
Yes No All my letters are written with almost no mention of myself.
Yes No I usually keep the same opinion about things.
Yes No I can sometimes get other people to think the same way I do.
Yes No I trust most people.
Yes No I like to have people watch me when I work.

2. *Emotionality*. The Pressey X–O test is one of the best-known tests in this field, although the older association tests of Jung and Rosanoff are closely related to it. The latter tests consist of lists of words to each of which the subject responds with the first word that comes into his mind. In the Rosanoff test the response words are given value on the basis of the number of times the word was given by one thousand persons.

The Pressey X-O test consists of four parts. Each part contains lists of words from which the subject is to cross out the words which stand for unpleasantness, for things for which a person may be blamed, or about which the subject has felt worried or nervous. The score is the number of words crossed out. A sample from Part I of this test is given below.

Sample Items from the Pressey X–O Tests

(Used by permission of C. H. Stoelting & Co., Chicago.)

Test I

Read over the twenty-five lists of words on the page below and cross out every word whose meaning is unpleasant to you — every word which you do not like. You may cross out as many or as few words as you wish; but be sure to cross out everything that is unpleasant.

1. disgust fear sex suspicion aunt.
2. roar divorce dislike sidewalk wiggle.
3. naked snicker wonder spit fight.
4. failure home rotting snake hug.

3. *Aggressiveness.* There are two tests of aggressiveness. The older is the Moore-Gilliland test, which consists of five parts. The first two parts are measures of distraction in adding caused by staring at the experimenter during the process. Both rate and number of eye-movements are counted. The third compares the rate of writing at a normal speed with writing at the most rapid rate. The fourth and fifth tests are concerned with the time required and the kinds of associations made with the stimulus words, *enterprise, company, success, danger,* and *death.*

Much more recently the two Allports have constructed an Ascendence-Submission test which has certain advantages over the Aggressiveness test. It consists of a series of questions about personal attitudes with appropriate scoring devices for evaluating the answers. This test has been found to have high validity and reliability.

4. *Ideals.* Voelker constructed a test of ideals. It consists of several parts. A typical problem requires the subject, with

eyes closed, to make crosses in a series of circles irregularly placed on a sheet of paper. The only way a high score can be made is by peeking. In another part, problems in arithmetic are to be solved. Answers are afterwards shown and the subject is given the opportunity to cheat by changing his answers. A sheet of paraffined paper placed underneath the first sheet shows any changes which are made. May and Hartshorn have improved and extended these tests in their extensive and constructive *Studies of Deceit.*

5. *Volition.* Any list of personality traits would not be complete without some mention of the Downey Will-Profile test. This was one of the first tests in this field and has had extensive use. It is called a test of volition or motive power. Although the test has had wide use, there is some question as to just what capacity it measures.

Evaluation of Personality Tests. What value can come from the use of such tests as these? Let us admit at the beginning that most of the tests here listed have little practical use. They are to be treated as experiments in test construction rather than as finished tests. Much more work must be done before we can delineate personality in terms of such tests. They are in much the same state as the early intelligence tests before the construction of the Binet tests. When comparable work is expended upon these types of personality tests, it seems likely that they will have as much validity and reliability as intelligence tests now have.

There has been a certain amount of skepticism even regarding intelligence tests. This is largely because too much has been expected of them. Even social intelligence is only one factor in personality. Other factors enter to counteract or to reënforce intelligence. When we are able to measure these other factors and evaluate them, we shall have a scientific approach to the problems of personality. Let us repeat that several problems remain to be solved before this is possible. Furthermore few of the existing tests of personality have proved themselves of general usefulness. Nevertheless they represent a movement in the right direction. They point the way to progress in the measurement of personality.

Personality Tests in Vocational Guidance. In this and the preceding chapters we have referred to the general principles of vocational guidance and selection. In the preceding chapter we considered the use of intelligence tests in both guidance and selection. As pointed out there, intelligence tests can be used to considerable advantage, especially in guidance and the higher grades of employment. In addition to intelligence tests there are other prognostic tests as well as certain vocational tests which may aid in vocational guidance and selection. Since personality characteristics are important in success or failure in life, the personality traits of a child must be taken into account in any system of guidance. The student, his parents, and his teachers must consider his various abilities as shown by school records and tests, as well as his interest, and use these as aids in the selection of the type of work in which he is most likely to succeed. The final selection should be made only after carefully weighing all these factors.

In any selective process industry must be concerned with the personality of the employee. In the light of the present tendency we have considerable assurance that at least a few tests of value, other than those of intelligence, will be devised in this field in the future. In the meantime we must be content to make as careful an estimate as possible of the traits which are demanded in any occupation. This estimate should be followed by a study of the prospective employee, using all the objective data available in the endeavor to determine whether he possesses the requisite ability and interests or whether he can be trained so that he will possess them to a satisfactory degree. The same general methods, together with the records of achievement, can be used in considering an employee for promotion. No simple formula can be established to solve this difficult problem.

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CHAPTER XIII

SOCIAL BEHAVIOR

LIV. UNIVERSALITY AND SIGNIFICANCE OF SOCIAL BEHAVIOR

Wherever organisms must live in proximity, they must adjust to the stimuli which such a situation produces. Even in lower animals social behavior is sometimes very complex, but in creatures as complex as man, living is a social order which becomes more and more intricate as time goes on because social responses form an increasing proportion of the adjustments made. Life would be relatively simple were it not for other people.

Orientation. In the earlier chapters of this text we discussed stimuli and responses of the sort that are largely unaffected by social relations. In some of the later chapters social influences have played a large part in our discussion. In the chapter on mental alertness it was pointed out that intelligent behavior is dependent upon the effects of social contacts between the child and his parents, teachers, and others. Personality, although probably dependent upon some inherent bases, is largely a matter of our relations to other people. In this chapter we shall consider the origins of social behavior, the way in which it develops, and its significance in life.

Importance of Social Behavior. If it were possible to specify all the causal factors in human conduct and to assign them relative values, it is quite likely that the highest values would be given to those elements which are dependent upon our relations with other people. Social influence may be of a very vague sort, as when we are observed by others even if we are not acquainted with them; or social influence may be very specific in form, as when we are in the company of a particular person whom we love or hate.

Social Reactions Are Learned. Social behavior, at first thought, may seem to present some new factors or elements other than those found in non-social behavior. It is true that social factors make behavior more complex and possibly less predictable, but there is no mysterious power or force present that does not exist in other forms of behavior.

In the usual objective non-social situation there tends to be a relation, although not a perfect one, between the strength and kind of the stimulus and the strength and kind of response. For example, if we are walking up a hill, we adjust our steps to the steepness of the hill. The steeper the hill, the more adjustment we must make in our walking. If we hear a sound, the type of our response tends to be tempered to the loudness of the sound. When it gets above a certain intensity, we are likely to withdraw or protect ourselves from it. The louder the sound, the stronger our response tends to be. Learning and previous experience play a part in such reactions, but they play an increasingly important rôle as these stimuli take on social significance.

In social behavior experience is a great factor. The type rather than the strength of the stimulus is the important element. For example, the amount of energy required to say, " I like that dress very much " and " I think you have made a poor choice " is about the same; but the social significance of the two remarks will be quite different.

To emphasize further the factor of experience in social reactions, we need only mention that if the above statements were made to a person who did not understand English, and if they were spoken in the same tone of voice, they would not be likely to evoke different kinds of responses.

The author knew a young man who enlisted in the Spanish-American War, was sent to Cuba, and was stationed in a home where Spanish was the only language known. This man knew no Spanish and with difficulty was making himself understood. One day while seated by himself in a room, a cat chanced to cross the floor. The man's first thought was, "Well, here at last is something that will understand me," and he began to call "kitty, kitty," but the cat made not the slightest response. The cat also understood only Spanish. It did not respond to "kitty"; it was a "*gatito.*"

Social Coöperation among the Lower Animals. We find many examples of social coöperation in the lower animals. In such animals as bees and ants the principle of coöperation is highly developed. The bees in a hive have an elaborate division of labor. Some gather honey, some carry water, others care for the queen, while others act as a standing army, always ready to defend the hive. Here we have an excellent example of a division of labor with consequent interdependence between the different groups.

Many of the higher animals also are gregarious. Many birds migrate in flocks. In the case of wild ducks and wild geese there is great social coöperation. Just how they organize in their characteristic way for flight is not known, but it is clear that, as they move in line formation, there must be an adaptation of each bird to the group in order to preserve the formation.

Many animals, like wolves and dogs, hunt in packs. When the chase is on, the baying of one dog acts as a cue to the others. In this way the pack is guided. As a result of such coöperation more food is obtained than by separate endeavor.

We should note at this point that social behavior differs from other types of behavior only in that either the stimulus comes from another animal of the same or similar type, or the response affects an animal of the same or similar type. Slight movements of a bird in flight cause a change in the flight of other birds. A certain call of a mother brings the young to food. The movements and the call are social stimuli. The response of the birds and the response of the young are social responses.

There is one further characteristic of social behavior. It is predominantly reciprocal in character. One social response is likely to become a stimulus to a second social response. When a dog barks at or bites a bone, the bone does not directly react upon the dog. But if a dog barks at or bites another dog, the second dog is likely to bark or bite in return. This response of the second dog in turn becomes an added stimulus to the first dog. This reciprocal character of social behavior is very important and will receive further consideration in a later part of the chapter.

First Social Reactions of Infants. Man is predominantly social. The child from birth is very helpless and is cared for by parent or nurse. Because of this dependence, and because of his capacity to learn, the child soon forms habits of producing social stimuli and of reacting to social stimuli. The child soon learns the significance of crying. His first cries are probably purely reflexive, but he soon forms the connection between a cry and the coming of the mother or nurse. As he grows older, he learns the value of other kinds of stimuli. Laughs, babbles, upraised arms, scratching, pulling hair, tearing papers — all have social significance.

He also learns to respond to the stimuli received from others. If mother speaks in harsh tones, he withdraws. If she caresses, he babbles and returns the caresses. Frowns and laughter, attention and neglect all have their place with him as controlling factors in his behavior.

LV. Influence of Learning upon Social Behavior

Through the mechanism of conditioned reaction the child learns to respond effectively to relatively simple social situations. As he matures, he sees greater and greater significance in social situations, and at the same time adopts more and more clever ways of responding to the persons about him.

Social Reactions Learned in Infancy. Some early writers ascribed the influence of others upon our conduct to the operation of an instinct of sociability. If such an instinct exists, it operates in a very vague and crude way at birth, and the specific reactions to others are dependent upon the specific experiences of each person with others. That is to say, the reactions we make to others are simply a form of conditioned reaction which is developed in the same manner as any conditioned reaction. The infant is hungry and is satisfied through the ministrations of the mother or nurse. The presence of the mother or nurse subsequently produces the same pleasurable reaction without the actual giving of food that the satiation of hunger did. This is the familiar mechanism of the conditioned reflex and can be used to explain all our reactions to others.

If some painful situation is always experienced in connection with a certain person or persons, in like manner the child becomes conditioned to dislike those who are present in such experiences.

Much Social Learning Is Unintentional Learning. Furthermore, this conditioning process in the child is not a thing that is always produced by the conscious intention of the adult involved. Very often the adult is planning to accomplish one end in his contact with the child, while the child may be responding in a manner which relates to some other end. A good illustration of this type of situation can easily be observed in the development of feeding-problems in children.

A mother with a child who is slightly underweight consults a physician and is told that she must feed the child certain foods to bring him to normal weight. Because she is very much worried over the situation, she undertakes to carry out the orders of the physician to the letter. Her conscious aim is to provide nourishment for the child. The dominant note in the whole situation is her worried attitude as she feeds him. The child reacts to this anxiety, and the feeding situation becomes invested with a dislike because of the mother's emotion. He learns to dislike the food that the mother is so anxious for him to eat. Her anxiety overshadows the pleasant taste of the food and he hates it. That such a theory is not mere fiction has been demonstrated by experiment. One can change the attitude of a tiny baby toward his bottle by the tone of voice and emotional expression that one uses in giving it to the child. If this can be accomplished in so simple a situation, we can readily see how in more complex situations the influence of human reactions can become very important.

In social learning, as in other experiences, the individual soon begins to generalize. If a person with big glasses frightens a child, big glasses may become a perceptual cue for undesirable persons and he subsequently reacts negatively to anyone wearing big glasses. Many of our reactions to other persons are based upon just such silly causes as this. Such responses appear silly, but they are perfectly sensible when we consider how they become organized. They are just as sensible as is the flow of saliva in the dog's mouth when he hears the bell ring after he has experienced the bell and the meat together. (See page 66.)

Emotions in Social Behavior. The emotional reactions of others are without doubt the ones which influence us most. If an act of ours produces anger or sorrow in others, we tend to refrain from repeating this act. If they show joy or amusement we tend to continue it. We recognize this principle in the conduct of children. The child is an inveterate "show-off" if he is encouraged by the laughs of his auditors; or he can become very shy if he is frightened by visitors or by the scoldings of his mother because of his crude conduct in the presence of company.

As the child grows older the wealth of these stimuli and his responses grow. The child learns to ask favors of father when the latter talks and has a happy face. He finds that after a good meal is a better time than before a meal to present his request. The growing son knows when to ask for permission to go out at night and when it is better to go without asking. He also learns when it is worse than useless to ask. Sister lays her plans well before she asks for the new dress or coat, or permission to bring company home. At times, or with some parents, kindness works best, but sometimes crying, whining, complaining, teasing, or a tantrum is most effective. Here we get a hint as to how dispositions are developed.

In more involved conduct the emotional reactions of other persons are probably the most dominant motivating force. The child, even though he knows nothing of the principles involved, refrains from doing certain things because experience has taught him that some adult may become angry. For example, a little boy came home from school one day and told his father he had said an "awful bad word" in school. He said the teacher got so cross that he knew it was "awful bad" and he would not say it again. After a lot of persuasion he was induced to whisper the word to his father. It was: "I don't care." The boy, having done something which vexed his teacher, had mistaken the cause of her attitude, attributing it to the expression he used. This illustrates how easily erroneous ideas can become fixed in the child's experiences.

Careful analysis will usually show that all conduct, even the most intricate and that which can be explained in terms of moral precepts, in the last analysis has this sort of develop-mental history. It is largely conditioned by our specific experiences with human beings.

Learning of General Social Attitudes. In a general sense a person's experiences with other human beings may have been of a sort to condition him positively. If the majority of his experiences have been happy ones, he will tend to seek out the company of others in order to reproduce such pleasurable situations. If, on the other hand, he has been unfortunate in his social contacts, he may shun company to avoid future unpleasant situations.

In addition to the specific conditioning which determines our conduct there is a general social motivation which should be mentioned. It is the sort of thing which comes not through the influence of any specific acquaintances, but is our reaction to people in general.

We tend to avoid the expression of too much interest or disapproval on the part of people in general. To have others look at us with raised eyebrows, or to be given a cold stare is more than some persons can bear. They will do almost anything to avoid such treatment.

Some Typical Social Reactions. The ways in which conduct may be used to influence others are so complex that we cannot hope to analyze or enumerate them all. A few typical instances will serve to illustrate the principles involved.

Direct criticism either by word or look may have one of two effects. It may cause (a) chagrin and either a cessation of the activity or flight from the situation which produced the criticism, or (b) an antagonistic reaction against the person or persons giving the criticism. In other words, the individual who is criticized will be chagrined or will compensate and show directly or indirectly that the criticism was undeserved.

If some one acts with too great dignity in our presence, we revere him, or resent his airs and feel inferior, or try to demonstrate that his dignity is unwarranted. All personal comparisons are odious, and when a person accentuates any differences between ourselves and him, we resent it.

Sometimes if some one does us a favor, the result is not the expected one of love for the person giving the gift, but of resentment that we have been placed under obligation to him. The influence of such conduct is based not so much on the outward act as on our interpretation of the attitude which prompted it.

These various illustrations of the complexity of social influence could be multiplied indefinitely. There is one general principle which underlies them all; namely, *we tend to act positively toward and to like those who make us feel better, nobler, more intelligent, or more efficient. We tend to act negatively toward those who make us feel unhappy, ignoble, ignorant, or inefficient.*

Abbreviated Social Reactions. As experience in the perception of social stimulation increases, short cuts and abbreviations come to take the place of total reactions. A dog gnawing a bone does not leave the bone to attack an intruder. A growl is sufficient if the second dog has had some unsuccessful experiences in such situations. Professor Woodworth characteristically describes these as a kind of preparatory response. He says, "It frightens the enemy away and saves the bother of actually attacking 'small fry.'"

These abbreviated responses come to play a larger and larger part in the life of the child. He learns both to understand this type of stimuli and to use it as a means of controlling others. The wink, for example, has taken on an important social significance. Professor McDougall explains the evolution of a sneer from a complex response of disgust. Disgust at one time was generally expressed toward objects which had a bad odor. The muscles which expand and raise the nostrils were contracted to exclude bad odors from the organs of smell. The head was turned, and even the raising of the hands was sometimes added to shove the obnoxious substance away. These were satisfactory direct responses to the situation. In civilized societies this response has little explicit use, but a remnant of it remains in the significant facial movements sometimes accompanied by the turning of the head and a gesture of the hands, palms outward. This account may be a bit fantastical, but it illustrates a principle which is probably sound.

LVI. The Function of Symbolism in Social Behavior

The most important means of social communication is language. Language began with gesturing, was continued in vocal expression, and finally developed into written language. A child born into a civilized environment falls heir to the language of his ancestors, and merely has to learn the symbols which have been evolved and standardized.

Symbolic Responses. Now let us consider the whole problem of symbolic stimuli and symbolic responses. We find these reactions, as has already been mentioned, in the lower animals. In general the higher we go in the animal scale, the more use we find made of this type of response. In man it reaches its highest development. Man's superiority over the lower animals is almost completely to be explained on the ground that he makes so much wider use of symbolism. How man developed this ability has not been answered satisfactorily.

Whatever the origin, man's advantage can be explained largely upon the basis of his social inheritance of customs, traditions, habits, skills, and language, both written and spoken. It is interesting to conjecture what would happen if man were suddenly and completely bereft of all this social heritage. Would he rapidly develop a new heritage, including language, and regain his place in the animal kingdom, or would he drop to the level of the beasts? Because of his great intellectual powers, he would probably develop a language; but certainly the process would be slow and laborious. In his racial development language was a slow acquisition and its redevelopment would no doubt be slow.

Let us now trace the significant steps leading up to the origin of language and some of the significant facts in its use.

Gesture. Gesture represents an earlier, simpler form of social communication. It is a form of behavior one individual makes for the purpose of indirectly controlling the conduct of another. By indirectly, we mean that the control is not by direct physical contact, but rather by reference to some experience common to both the persons concerned. In the case of the growl of the dog to which we have already referred, the first dog did not directly attack the second dog, but attempted to control his behavior by reference to some experience common to both.

Of course when first used the significance of the gesture is not likely to be appreciated by the one who makes the gesture. In the example just cited the first time the dog growled under such circumstances it was probably only a preparatory response to a proposed attack. The growl was probably used several times before its social significance became apparent. Indeed, there is considerable question as to just how well the dog ever understands the social significance of his acts. The second dog must also understand the significance of the gesture. If he does not, the attack must become overt. This illustration shows the necessary coöperative features in gesture.

Gesture begins very early in the life of the child. His first movements are overt. But soon these overt movements are abbreviated and become symbolic. The child first moves his head from side to side to avoid food after he has had as much as he wants, or to avoid other things he does not want. From this movement develops the side-to-side movement of the head to denote negation. Similarly the up-and-down movement of the head, which is a characteristic movement of the child in taking food, becomes the basis for the nod of affirmation.

Other gestures develop quickly. The child soon learns to wave his hands, to "patty-cake," to show "so big," and to make many more such movements. In many cases adults make use of gestures. In addition to the normal use made by any adult in speaking, we have the special cases of this method of communication between people who do not speak the same language. It is possible to carry on quite an extended conversation in this way. Travelers in foreign countries have little trouble in expressing their needs. The Indians made extensive use of gestures. The deaf are compelled to make much use of signs and gestures. Their gestures become both elaborated as to amount of use made of them and simplified as to form. They evolve methods of expressing complicated as well as abstract ideas by gestures. The manual alphabet is the further elaboration of these methods.

Wigwagging and other army methods of signaling are further types of gestures which have become highly conventionalized. Such methods of communication depend upon the use of a carefully constructed and well-prepared code known to both the sender and the receiver.

Language. There are, however, several limitations to all manual forms of communication: (1) Such communication can only be carried on when the receiver is looking. It does not provide a method of gaining attention. (2) It cannot be carried on effectively in the dark or when the parties to the conversation are not in sight of each other. (3) It cannot be carried on when either the sender or the receiver is engaged in any other type of work requiring attention. If the sender's hands are occupied at other work, he cannot gesture. (4) The range and variety of expression probably has more limitation in gesture than in vocalization.

The Development of Language. We do not know how language originated. Many theories have been proposed, many of which, no doubt, contain considerable truth. But no one explanation is complete; language developed from many sources and in many ways. It evidently required many generations to develop a language. In fact all living languages are continuously in process of change and elaboration. Different peoples have evolved their languages more or less independently. Therefore we have not one but many languages.

One interesting thing about the development of any language is the orderliness with which it proceeds. All except a few very modern and artificial languages were constructed and perfected before the grammar of the language was written. The unusual fact about the whole process is that there could be a system superimposed setting forth general laws and rules of grammar. While the grammar differs for different languages, there are rules and laws governing all languages. We can only marvel at the great complexity and withal the great uniformity in structure. Inflections indicating parts of speech, person, case, mood, and tense were all evolved probably before their significance was appreciated. Only after the first grammar was written was it possible to see all these forms in all their relationships.

We have already pointed out several of the advantages of language. It is a more flexible and versatile form of communication than any other. It is through language that man accumulates culture from generation to generation. Language can also be used to indicate things not immediately present to the senses. That is, it forms a basis for man to deal with the future in terms of past experience. It also constitutes a means for dealing with many qualitative relations, abstract ideas, and generalizations. It is difficult to express *white* or *goodness* by gesture. How could *by*, *yet*, or almost any other adverb or preposition be expressed except in language? Language was without doubt man's greatest single step in progress.

The construction of written or printed symbols to indicate words and meanings was a difficult and important step which followed the development of spoken language. Written language is the method of conserving what has been evolved in spoken language. After its development has reached a certain stage, written language furnishes a method for the derivation of new materials and ideas. By means of new combinations, new results follow.

Several steps must have been involved in the development of a written language. First, no doubt, printed symbols stood for spoken words or ideas. Later an alphabet was devised. This made it possible to standardize a few symbols to represent many words. The old Chinese language is one that has never arrived at this later stage. There is a separate character for each word.

The Child's Language. Thus far we have been considering the way in which civilization developed language. Let us now consider how a child learns a language. The child is born into a home where some language is already in use. Instead of having to work out a language for himself, the child must learn the language of his associates. If he lives in France, he learns to speak and write French. If he lives in the United States, in most sections of the country he will learn English.

In the beginning the child makes many vocalizations. Some of these seem to be only a form of random movement. Others are expressions of feelings and emotions, such as pleasure, joy, unpleasantness, sorrow, and anger. These vocalizations become fixed through practice. A point upon which psychologists are not agreed is whether the child may imitate new sounds after hearing them produced by others. At least after the sound has been produced, it is only a matter of association for the child to connect names of objects with the objects themselves. Other forms of speech are learned by following the usage of other persons. The second and third years of a child's life are occupied with this learning process. Through random vocalization, trial and error, corrections, and example the child gradually learns how to make his wants and thoughts known. Indeed, as was pointed out in Chapter IX, thinking is largely, if not completely, a matter of inner language. Some one has described thinking as a method of signaling to oneself.

Music and Art as Forms of Symbolism. Language tends to be a form of specific symbolism. Music is a form of nonspecific symbolism. There is in the composer's mind a general emotion to be expressed. The performer and the hearer may get different emotions from those of the composer; nevertheless they get some response or the music is meaningless. Art is another method of expressing general ideas or emotions. The ideas of the sculptor or painter may be more apparent than those of the composer, yet they are general rather than specific. They are forms of a universal symbolism.

LVII. Social Behavior as Expressed in Organizations and Institutions

Social influences affect the individual in relation to his fellows. It is the development of this relation that we have been considering thus far in this chapter. These social relations also express themselves in another way; namely, in organizations and institutions. The home, the church, the state, and the school are institutions which are a direct outgrowth of social relations. Custom, tradition, and public opinion are other forms of group control, but they are expressed in a number of different ways rather than through any single institution.

Universality of Social Institutions. One drive, or at most, a few fundamental drives, forms the basis for the organization of most social institutions. In some cases these basic drives are rather apparent; in others they are almost completely hidden by the forms and directions of their expression. The forms of expression of these drives have varied from one generation to another. This variation in some cases is so extreme that the basic factors are almost unrecognizable. Thus, the nature and form of the home have varied. Religion has varied, and continues to vary from time to time and from one people to another. The form of our schools is greatly different from what it was even two decades ago. Governments may change rapidly. Yet underlying all these institutions and the changes that affect them we find a dominant need or urge.

Let us now consider some of these organizations and institutions in more detail, pointing out wherever possible the innate bases upon which they are founded, and some of the characteristic forms of their expression. An elaborate discussion of these institutions would introduce problems of social psychology and sociology, and would extend beyond the scope of this text. It is for this reason, and not that these institutions are regarded as relatively unimportant in our lives, that the treatment of each is limited and brief.

The Home. The home is the basic human institution. It is fundamental and forms the basis upon which many of the other social structures, such as education, public opinion, and government are built. Without doubt the fundamental drives upon which the home is founded are few in number. Sex is one. If there be a separate, innate parental instinct, it should also be mentioned. Gregariousness, whether or not it has an innate basis, is a large factor in home life. If love is more than a combination of the drives already named (although it probably is not), it should be included in our list of the innate bases of the home.

Within the home we find a necessary adaptation which beautifully illustrates the principle of reciprocal social behavior. It is ordinarily in the home that the child receives his first and most fundamental training in social adaptation. It is here that the child learns the significance of social stimuli, develops methods of producing social stimulation, and learns methods of responding to such stimuli. Since these mechanisms have already been described, no further discussion of them is needed at this point.

Religion. In primitive religion fear of the unknown is a large element. Coupled with this fear there is developed the idea of protection from the fearful situations by submission and worship, and the feared object becomes revered as a god. Since religion and worship are large components in home life, we get an intermingling of the early religious drives with those of the home. As religion develops, there is a general lessening of the fear elements and a greater emphasis on the idea of the fatherhood of God and the brotherhood of man. These basal ideas find expression in elaborate institutions, with the church as the foundation.

Government. As civilization advanced, the idea of the home became extended. There developed the tribe and later the state. As the functions of the tribe and state became enlarged, the problems of government became greater. The king was father to the larger group. But the parental function became subdivided into the executive, legislative, and judicial branches. Authority in the modern state is delegated to a number of individuals rather than to one absolute monarch.

In the organization of the tribe and of the early states the ruler held his position by birth. This closely simulated the home. In general it has now been found that it is better to elect the ruler. Although the method of selection has changed, and his authority has diminished, rulers still exercise many of the powers and responsibilities of a parent.

The methods of exercising power, the direction of this power, and the amount of such exercise vary from state to state and, within any state, from time to time. Sometimes the state becomes very paternalistic; again less authority is exercised.

Law. Law is one expression of government. It is a definite system of social controls. The laws are usually codified by authorized representatives of the people, and are supported specifically by group force. As a means of social control modern law depends upon three things, (1) public opinion, (2) the degree to which the people are educated to recognize its validity and usefulness, and (3) the effectiveness with which it is enforced. When law depends largely upon authorized force, it is never an effective stimulus for social adjustment. A public opinion contrary to the law in a sense nullifies the law. Education of the people to the inhibition of such behavior as the law prohibits may eventually overcome the effect of public opinion or the law may be changed to fit public opinion.

Customs and Conventions. These are the products of social tradition. In modern times, monogamy, rather than polygamy and polyandry, is accepted as the proper marital relationship. The home, rather than the state, is considered the most suitable institution for the development of the young. Medical science, rather than charms and prayer papers, is held to be the most social method of treating the sick. The social tradition gains its authority at first because in some way it furthers or protects the integrity of the group. Then it becomes set as a social control and because of inertia persists even after the time has passed when it has immediate significance. Eventually some environmental necessity or economic change overcomes the inertia and variations in the custom and conventions occur.

Because they can be altered, custom and convention possess only relative power as control agencies. This is a fortunate condition. Social progress depends upon the plasticity of the social pattern which acts as a control on the individuals who react to it.

Public Opinion. Public opinion is a form of social control which is not only very powerful but also almost universal. In the tribes of the African jungle, as well as in Chicago society circles, public opinion is almost a fetish. Its effect on social adjustment is immediately felt in all grades of society. The availability of books, magazines, newspapers, and the radio for the average man has made possible the creation of a public opinion based largely on the ideas and desires of a particular group of persons who control these agencies. The newspapers, through the space they give to specific news, through editorials and cartoons, mold public opinion. They may appeal to prejudice and emotions as well as to the intellect. They may, through definite propaganda, change the behavior of a nation. During the World War the value of organized propaganda was very evident. It made possible the welding of millions into a relatively integrated unit. The rational, social, and emotional life of a people was swayed into the specific form of adjustment which would produce the results sought by those in authority.

The influence of public opinion may be either good or bad. It is equally strong for either. Fashions are set, new songs become popular, new methods of transportation are developed, and even new moral and social attitudes are set up through public opinion.

Because man is so much a social animal requiring for his complete satisfactions the approval and approbation of his kind, there is a very powerful tendency on his part to adjust socially in such a way that he will become identified with the group in which he moves. He takes on the protective coloring of that group as far as his social adjustments are concerned. Social approval is a very powerful means of control in modern society.

Education. Education has been recognized for many years as the greatest agency for social control. During modern times the extended efforts on the part of governments and civilized people everywhere to raise the level of intellectual achievement is eloquent evidence of this fact. Ignorance and superstition are not conducive to a sense of social values.

In a very real sense all other agencies for social control depend upon education. Without this principle as the basis of social progress, civilization would develop very slowly. The person who is capable of taking a rational, rather than an emotional, view of his world and the immediate circumstances to which he must adjust himself is in a position to make his adjustment in terms of social and rational ends that are desirable rather than in terms of the fears or anxieties which disturb him. "There is no darkness but ignorance." Education results in the appreciation of causal relationships, as well as the development of social values. In this way it becomes the greatest form of social control that we know. The informed individual is likely to see the particular problems of adjustment that confront him in terms of their significance to life as a whole; the uninformed person, knowing little about a situation beyond his immediate desires and needs, is less likely to make an adequate social adjustment.

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CHAPTER XIV

PERSONAL EFFICIENCY AND MOTIVATION

LVIII. Analysis of Human Motivation

If the human being is maladjusted, he uses all the devices at hand to attain a better adjustment. If he were thoroughly satisfied, all motivation to activity would cease. This general urge for relief from dissatisfaction takes many specific forms, but for general discussion it may be subdivided into (1) attempts to satisfy hunger, (2) gratification of sexual impulses, (3) attempts to secure freedom of movement, and (4) the satisfaction of organic needs.

Why Organisms Are Active. In a broad sense, the underlying cause of activity of any sort on the part of an organism is a condition of maladjustment. This maladjustment may be within the organism or it may be a lack of adjustment between the organism and its environment. The activity is an attempt on the part of the organism to create a better balance. Activity of this sort is seen in its simplest form in reflex responses. If the finger touches a hot stove, the arm is withdrawn because the pain receptors inform the organism that something is wrong. If a bright light shines into the eye, this maladjustment is rectified by a reflex narrowing of the pupil. To be sure, the maladjustment need not be pathological, and may be ever so slight in amount. If the resultant activity produces an adjustment, activity ceases; if the maladjustment continues, response of some sort continues until the organism is brought to a condition of adjustment.

Moreover, this continual attempt at adjusting seems to be never ending. As soon as one situation is met, others arise, and their solutions, in turn, are followed by other problems. The notion that some day everything will be adjusted is, in view of the facts of life, a silly ideal, impossible of fulfillment as long as we are alive. Life means awareness of the significance of maladjusting elements and an attempt to meet them. When little significance is given to the various factors of life, adjustment seems relatively easy. The infant, for example, not understanding the meaning of his environment, is easily satisfied and spends most of his time in sleep. The alert man is continually busy, never satisfied, indeed, expecting never to be completely satisfied. He has learned to get his satisfaction in the thrill of attempting to meet life as it is, not in a release from the necessity to adjust.

Heretofore in this text, we have been studying the mechanisms by means of which we become cognizant of our environment and the responses by means of which such adjustment is effected. Now we shall study the nature of the driving forces of life and the manner in which these may act most efficiently.

Distinction between Motivation and Mechanism. The nervous system of man is without doubt the most intricate mechanism in existence. It has a vast number of component parts so organized that the interactions are practically without number. One should never lose sight of this fact. In studying the mechanism, however, one is likely to become so absorbed in its wonders that little attention is given to the things which make the mechanism operate. Man is no doubt a machine, but he is something more; he is a vitalized machine, a machine with sources of energy harnessed to make it function properly. An industrial plant with cold fires is just as complex a mechanism as when it is in operation, but an adequate description of such a plant should include a description of it in operation; there should be a description of the part played by the harnessed energy. A dead man is just as complex a being as a live man, but anatomy and histology will never tell us all about a man; we must see him in operation.

The mechanisms of man can, therefore, be considered as an apparatus through which the motive forces operate. These motive forces are all ready to function in a well-unified personality and all they need is the sensory stimulus to set them off. The sensory stimulus acts as a trigger which releases the drive through the proper channels. We cannot function without the trigger, nor can the trigger prove effective unless the internal conditions are so set that they will respond.

This conception need not lead us to a positing of some mysterious agency behind activity. The motive forces operate according to definite laws just as the mechanism does. The difficulty that has been encountered in thinking of this problem has been the tendency to go to either one of two extremes: to assert that man is nothing but a mechanism, or to believe that he is actuated by a mysterious force which does not conform to law. Our position is that forces of some sort are essential in the conduct of man, but that these forces operate in a lawful manner.

General Sources of Motivation. We shall first consider the forces that urge man to attempt to adjust himself, and then later attempt to show how these forces act in specific patterns. Pointing out a general motivation does not explain all its manifestations; it serves only as a starting point from which to trace its specific influences.

1. *Hunger.* That hunger is a motive force of the most vital sort man has long recognized. When hungry, a man will do things which seem foolhardy or immoral to the man who has had his hunger satisfied. Much of the history of man can only be understood when it is recognized that the driving element was the necessity of providing food.

But, while we grant that in the history of man, hunger played a dominant rôle, can we say that it is as important now? Certainly we do not see men striving, fighting, and working merely for food. There are few of us in this civilized age who actually know what it is to be genuinely hungry. Practically none of us have ever had presented to us the alternative of fighting for something to eat or starving. But this does not mean that the hunger motive is not important. It simply indicates to us that the hunger motive manifests itself in very complex forms instead of in the crude forms in which we find it in animals or in primitive societies.

The primitive reaction was: hunger — eat. Or, if food was not at hand, this became modified into the form: hunger — fight — eat. In our civilization, it takes the form: hunger — work — money — buy — eat. Since working, distribution of foods, merchandising, and means of exchange are the greatest concern of our modern civilization, the place of the hunger motive is apparent. Indeed, it becomes so complex that the original motivation is usually lost sight of in the intricacies of the means adopted to satisfy it. Working, bartering, and social machinery become such an integral part of our lives that we take them for granted, and we cannot discern the urge behind our activity unless some unusual condition accentuates the urge.

2. *Sex.* Another motivating force of great importance is the urge toward sex adjustment. The question whether this motive force is stronger than that of hunger has never been satisfactorily answered, but in spite of our uncertainty on this point, we are all aware that the sexual drive in man has received more attention than any other. History, literature, art, science, and every other activity of man is filled with the romance of man working, struggling, and achieving for the woman he loves.

Here, again, we cannot understand motivation without recognizing that its expression is exceedingly complex. One does not explain an intricate bit of conduct with the simple statement that it is actuated by the sexual motive. The much larger problem is how it comes to take the intricate forms in which it is found.

In its primitive form, sex maladjustment will lead to excessive activity of a more or less useless sort. This was tested by Wang in an experiment with female albino rats. By confining them in a revolving cage, he could measure the distance each rat ran in a given time. By an accurate check made upon the degree of sexual maladjustment of each rat each day, he could discover whether there was any relation between sexual excitement and the distance run. He found that there was a very direct and close relationship between activity and sexual excitement in the rat.

While in the rat such maladjustment takes the form of sheer restlessness, in man it takes more worthy expression. A man or woman in love, instead of merely going through a lot of irrelevant movements, is stimulated to work harder at a vocation; to earn money enough to provide for a family; to plan means of enjoyment together, and the like. To be sure, we have, in dancing all night, a form of excess activity which is somewhat analogous to the activity of the rat, but this is a very small phase, and usually a passing one, in the whole phenomenon of romance in man.

3. *Freedom of movement.* Watson found that hampering the movement of a newborn child will arouse fighting, struggling reactions. In animals we can easily demonstrate that restraint is a natural stimulus to struggle. Originally this may be a reaction to gain freedom for physiological functions necessary for life, but it takes complex forms and is probably very important in much of man's life. A child who feels too much the restraint of parental authority will bend every energy to outwit his parents and gain freedom. Most of the things we desire become more potent in their influence upon us if we are prevented from attaining them. Once we have attained

the treasure, it loses its value. All these instances probably illustrate complications of a very simple mechanism — the urge for freedom of activity.

4. *Organic needs.* There are, no doubt, a number of organic needs which lead the organism to attempt adjustments of one sort or another. These have not been investigated with the thoroughness that they deserve, but what is known indicates that they are important in motivation.

The body has a mechanism which tends to keep it at a constant temperature. In a situation where the external temperature is too cold or too hot, there is excess activity in an attempt to gain a more favorable environment. This has been shown by an experiment in which tiny animals were placed in water of different temperatures. At the optimum temperature the animal swam placidly the whole length of the tube in which he was placed and then back again. When the temperature was raised, he would swim a short distance, turn back and then turn again, never swimming calmly the entire length of the tube. To a lesser degree the same thing happened when the animal was placed in a medium which was colder than the optimum.

We have a tendency to avoid harmful substances, painful stimuli, excessively loud noises, lights which are blinding in their brightness, odors which are too pungent, and tastes which are too bitter. These primitive defense reactions become integrated with all sorts of complex behavior in human society, but a careful analysis will reveal their presence.

LIX. Complex Expression of Motives

Motives take on multiple forms according to the complexities of the environment, as well as according to conditions within the organism itself. These complex expressions, being often repeated, assume the form of habitual expressions, which we call *sentiments.*

Elaboration of Motives. While we have given general names, such as *hunger, sex,* and *desire for freedom* to the basic motives of life, they express themselves only in very specific forms, and these specific forms are the result of specific experiences.

The human adult is hungry, but it takes specific kinds of food to satisfy him. He wants it cooked in a certain way and served in what he regards as an appetizing manner. He wants it in the company of his friends and in vessels which conform to his habits.

Knowledge of this fact is of practical value in the marketing of a new food. If the new food is very different from those that are enjoyed by the people to whom it is presented, it is not likely to become popular. A certain amount of difference may make it novel enough to induce sales, but one would have a hard time introducing such a dish as Hawaiian poi to Americans. It would be literally impossible to make eating it with the fingers, as the Hawaiians do, popular with Americans.

The same elaboration of impulse is found in the sex drive. In civilized human beings the mode of expression of the sex urge is very different from the crude manifestations of it that one may find in savage tribes or in animals. The human being goes through such an intricate network of conventions during courtship that he scarcely recognizes a great amount of his conduct as having any sexual basis at all. The fact that this motive becomes so elaborate gives fascination to our novels and dramas.

After these motivating forces become modified by convention and by training, they become so permanently fixed that we continue to act in certain ways from sheer habit. Consequently, in much of our conduct it is futile to attempt to trace back to the general motivating force each act which we perform. Habit in itself becomes the drive which makes us do the things we do. You may have to bribe a little boy to dress himself, but what man has to be bribed to accomplish this task?

Development of Effort. In popular discussion, we hear much of effort as a factor in efficiency. The man succeeds who knows how to exert himself and accomplish something of value. The layman is likely to conceive of this factor as a specific, motivating element which one either has the good fortune to possess or the ill fortune to lack. Such a conception is probably fallacious.

We have seen that resistance to free activity is the adequate stimulus for the manifestation of excessive vigor. The way to get a child to fight is to restrain him. If his activity results in some accomplishment, the child will tend at future times to exert himself in somewhat the same manner when resisted again. He thus can be taught to build up the habit of exerting himself in the face of resistance to his free activity. Effort can consequently be conceived as a habit. If one lacks in his display of effort, it is quite likely that he has not received the type of training we have suggested. The way to help such a person is to give him some stimulating but difficult task and see that he succeeds in it. Such a plan is much more desirable than to assume he has some inherent lack or that he was born lazy.

Fatigue. The ordinary mechanical device has to undergo repairs at various stages and usually, during the periods of repair, cannot function. The human machine also has to be continually repaired, but it is equipped with a device which enables much of this repair work to be accomplished while work is continued. When the human being becomes fatigued, his speed, or quantity of work, is diminished and the organism has an opportunity to recuperate. Fatigue really has two components. One is the feeling of fatigue, the subjective experience which makes the person feel as though he must slow down or stop work. The second is the actual incapacity of the organism to function efficiently. A definition which embraces both of these factors is: "Fatigue is the reduction in the output of work as the result of work, and which is recoverable by rest."[1]

The first or subjective factor in fatigue — namely, being tired — is a rather paradoxical phenomenon. One often feels tired when he has not done sufficient work to cause physiological fatigue and, conversely, after extended work when the organism surely should be somewhat depleted, one may feel fresh and energetic. The subjective factor should probably not be taken as any serious indicator of the need for recuperation. The way to deal with it is to provide additional incentives, so that work may be continued in spite of the feeling of fatigue. When such incentives are supplied, when interest is stimulated, it has been found that the feeling is very likely to disappear.

Nevertheless, if one considers only the subjective feelings and provides incentives to an extreme degree, he may finally produce a physiological incapacity. That there does operate a physiological incapacity after too much work can easily be demonstrated in the laboratory. A muscle from the leg of a frog can be stimulated to contract by means of an electrical stimulation. If such a muscle is made to contract at about the rate of one contraction a second, it in time begins to contract to a less and less degree until finally it cannot be made to contract at all. It has become so fatigued that it will not work any longer. If the muscle is allowed to rest, in time it will again respond to the electrical stimulus.

The person who has men working for him should apply both of these principles, so that he may produce the greatest efficiency in his men. Rest periods should be given at sufficiently frequent intervals to permit the effects of physiological fatigue to subside, but in addition, these rest periods should be

[1] Poffenberger, A. T., *Applied Psychology*, p. 134. Appleton, 1927.

periods of diversion when fresh incentives are given to the workmen so that the feeling of fatigue vanishes. A man resting for ten minutes, thinking all the time of how much he hates to get at his work again, may actually feel more tired at the end of his rest period than he did at the beginning.

Frequent short rest periods are better than longer rest periods spaced farther apart. This fact was demonstrated by Mosso in some laboratory experiments. He had subjects lift a weight by contracting the finger. He found that the finger became completely exhausted after the weight had been lifted thirty times, and that it took two hours of rest for complete recovery from the work. When, however, the work was stopped after the weight had been lifted only fifteen times, only half an hour was required for complete recovery. Therefore, two rest periods of half an hour each effected complete recovery from thirty pulls, whereas it required twice that much rest if no rest period was given until the finger was completely fatigued. Other experiments show that the work done when one is nearly exhausted is very costly in terms of time required to recover. Keep fresh by frequent rests.

Mental Fatigue. Because muscular fatigue is so easily demonstrated, one is tempted to assume that nerve tissue may become fatigued in the same maner. Experimental tests have failed to demonstrate any neural fatigue which is as complete or extensive as muscular fatigue. One can easily get the tired feeling from mental work, but the physiological deterioration resulting from such work has been very hard to demonstrate. There have been a few changes in nerve cells as a result of extreme stimulation, but these were in an experimental situation and the stimulus was stronger than any that would occur in ordinary life. Miss Arai, a Japanese student, did a heroic task in mental multiplication for long periods with very little specific loss in efficiency.

Mental work will produce physical fatigue of muscles which are held tense during such work, and it is quite likely that much that has been called mental fatigue has really been this physical fatigue.

Work as a Factor in Mental Health. To be able to have enough motivation to work efficiently and to plan work so that fatigue will not interfere excessively are not the most important conditions for work. We want to work efficiently, but we should work healthfully as well. It has been found that work is one of the best means of keeping mental balance that man has devised. A man who is beset with worries finds welcome relief in some occupation that is of interest to him. Lost in his work, he can, for the time being, forget his worries.

This fact has been recognized in recent years by physicians and in most modern hospitals there is a department of occupational therapy. In this department, the unfortunates who have lost their mental balance are given work, such as rug-making, carpentry, machine work, painting, and the like. Such occupational diversions have been found to be very beneficial.

How can the beneficial aspects of work be reconciled with the popular conception that one must be careful or he may break down from overwork? The answer is fairly simple. A study of those individuals who are supposed to have worked so hard that they had a so-called nervous breakdown show that they used their work as an attempt to escape from some worry or other mental difficulty. In spite of their work, the worry persisted in coming back, so that they had to work still harder to keep it away. This situation leads to a race in which the victim is running away from his trouble by working harder. When the break comes, the work is blamed, whereas the trouble that made him work excessively is the real cause. Such individuals can be identified by the fact that they always work feverishly. It matters not what the task is, they must be extreme in their prosecution of it. This shows that work is not always an escape. If the individual can work with normal vigor and thus escape this mental turmoil, it is beneficial. If he is working feverishly and is still pursued by his trouble, it is well for him to adopt some other means of overcoming his worry.

Motives Elaborated into Sentiments. We have indicated that in the conduct of adult man, the primitive motives are modified by experience to such an extent that his conduct cannot readily be traced to the elementary forms. What are apparent to the observer or to the man himself in his attempt to analyze his own motives are very complex patterns, which have been given the name *sentiments.*

Sentiments are relatively permanent systems of emotional habits. They are built up, as is any habit, by repetitions of the situations which call them forth, and are strong in proportion as the experiences or education of the individual have made them strong.

These sentiments may be of the constructive or destructive sort as measured by their value to the individual, but the principles upon which they are based are the same. For example, a person because of his favorable experiences with other people may have a strongly developed sentiment of loyalty. It has been built by having favorable results come from situations when his loyal reactions have brought him personal satisfaction. When firmly established, it becomes much stronger than the primitive impulse and cannot be understood by any attempt to resolve it into its elementary form.

In the same manner a sentiment of distrust may develop. If, when a person trusts others, he has his faith frequently rewarded by painful consequences, he may, as a result, tend to build up an emotional habit of hate, suspicion, or distrust which will color much of his behavior where others are concerned.

LX. Practical Applications of the Psychology of Motivation

To discover the motives behind the conduct of men and to use this knowledge in various ways to direct their conduct is of the greatest importance. If we knew exactly the motives which would activate a man, we could probably make him do anything we wished. It is because of our ignorance of the reasons behind his conduct that we are so often unable to understand him. For every bit of conduct, there must be an adequate cause. Conduct is never silly. It appears silly at times because we are ignorant of its background. With these propositions before us, let us see how motivation can be used in specific situations.

Vocational Guidance. Attempts to discover for what work a man is best fitted has taken two forms. The first is to give the man various tests to determine his abilities in different occupations. The assumption underlying this procedure is that a man can do best the work in which he has the greatest ability. Usually this is true, but if a man has great ability in a certain kind of work but, at the same time, has built up a sentiment against that work, he probably will not make a success of it. In other words, ability is not the only quality needed for success.

Another method that vocational guidance has developed is to determine the various interests of the individual. This is done by giving him a list of various types of activites and asking him to indicate the things which he likes and the things which he dislikes. By considering carefully things he likes, and choosing a vocation in which these are components he will be assured of an occupation which is fundamentally pleasing and in which he is very likely to succeed.

Advertising and Selling. In no field has the psychology of motivation been applied with greater success than in the field of advertising and selling. While a man theoretically should use only his reason in spending his money, it has been found that he more often purchases because of sentiments than because of any logical reason. In order to sell goods, one must make the customer want to buy them.

A technique that has been developed in this connection is to make extensive surveys of the likes and dislikes of people in relation to various articles. The results of these surveys have been used in modifying products in accordance with the likes expressed and also in formulating the advertising of the product to emphasize the things which people want.

A good illustration of this is seen in the changed policy in manufacturing and selling automobiles. At first it was thought that, since an automobile involved a considerable expenditure, the buyer would want a product which would last a long time. The earlier advertisements stressed the endurance of a car. But improvements came so fast and models changed so rapidly that people did not want a car that would last a lifetime; they wanted the latest model. Consequently, while we have cars now that will last much longer than the earlier models, no advertiser stresses the number of years his car may be used; he shows that it is the latest thing in automobiles.

Another striking instance is found in food advertising. Surveys have shown that people buy foods because they are tasty and clean. Consequently, the most successful food advertisements are the ones which portray a nicely served portion so realistically that the reader's hunger is aroused.

Development of Morale. When it is once clearly recognized that men do best the things that they want to do, employment management takes on a new light. Instead of placing employees where they can be closely watched, it has been found vastly more profitable to devise ways of making the men interested in their work.

A striking application of this was made in the morale work developed in the army in the World War. The old notion of army control was a discipline so strict that a man acted as an automaton. To take a vast body of recruits and get them into such a state of subserviency in a short time was found to be well-nigh impossible; so a system was evolved to make the men like army work. A morale division was organized which outlined a definite program calculated to make the man happy. It succeeded so well that establishments employing numbers of men would do well to pattern after it.

Conflicts of Motives. It remains to be said that all motives do not lead to harmonious activity. Each person's experiences are of such an order that he develops motives which are in conflict with each other. What we are accustomed to call moral training is training in inhibiting certain impulses under certain circumstances, and at times doing the things we like least well to do.

When a person is confronted with two contradictory motives of fairly equal strength, what is he to do? There are only three possible ways of reacting: he can choose the first motive and act on it; he can choose the second motive and act on it; or, he can compromise, and act in a way which is a modification of the two.

An interesting phenomenon occurs when he chooses one of the two conflicting acts. Having once started in the direction of the chosen one, he usually feels he must support that choice and act upon it much more strongly than if he had no previous conflict. Consequently, when you see a person acting with great decision, it must not be taken to mean that he never had a tendency to do the opposite. It is more likely to mean that he is afraid he will slip over into the opposite action. For example, a man may have had a motive to steal which was balanced against a motive of honesty. When finally the honesty wins, he is likely to be honest to the extreme.

The conflicts which lead to compromises are so innumerable that it would be futile to attempt to enumerate them. Such compromises account for many of the acts of men which appear on the surface to be foolish. Because an act seems to be foolish, it does not follow that the act is unmotivated. It is likely to be a disguised expression of some motive which has been suppressed for some reason.

LXI. Personal Efficiency

A person may be properly motivated; he may be in the type of work which interests him; he may have a goal toward which he is working; and he may have the capacity to carry out his work. But all of these favorable conditions do not imply that he is conducting his activities with the maximum efficiency. Motivation is the first essential to good work, but in addition, one must learn how to work. The development of efficient methods will vary with every occupation and each person must work out the details of his own program. Nevertheless, certain general principles, which we can outline here, will guide in the formulation of any individual program. In occupations where the work is fairly well defined, the organization of efficiency programs must be quite different from the organization of those programs which would help the man who is doing creative work. Each person must make his own adaptations.

Organization of Time Schedules. One of the most effective means for producing efficient work is to plan a time schedule for the work. This will be effective whether the jobs are mechanical or creative in nature. By doing some samples of the work under test conditions, an estimate can be made of the approximate time required. Using this sample as a guide, plan to do a certain amount of work in each unit of time, allowing short rest periods to intervene. It will be found that if such a procedure is followed, much more and better work can be done with less strain and in a shorter time. Writers who set themselves the task of doing a given amount of work each day or each week accomplish more than those who merely set out to work hard. The student who plans his study program and outlines what he must do in each period is likely to get it done. This procedure is literally setting up a time goal and working toward it.

Plot a Curve of Accomplishment. In addition to the apportioning of time, it is a good plan to keep a graphic record of what one has accomplished. In this manner, one sets up his own work as something to be improved upon. If the graph shows a constant improvement, one is encouraged to keep the curve moving in this direction. If it shows a decrease in production, it will act as a spur to make him do better work. This method has been used with great success in school work, in industries, and in situations where group motivation was required, and it can be used as effectively by an individual in the improvement of his own work.

Search for Better Ways of Doing Things. It is a good plan for any person, even if he regards himself as skillful in his special line, to ask himself whether he is doing his work in the best possible manner. The development of efficiency engineering has demonstrated that, where the efficiency of methods of work is questioned, much improvement can be brought about.

Gilbreth, in his studies of fatigue, found that the position of a worker had much to do with his efficiency. For example, an operator whose machine was so arranged that she had to stoop continually was able to improve her work when the machine was raised so that stooping became unnecessary. Typists have shown much improvement when a suitable type of chair is provided.

In some instances, the habits of work are so deeply rooted in custom and in the individual worker that it is hard to effect a change even when such a change is proved to be desirable. This condition obtains in typewriting. The standard keyboard is not the most efficient arrangement of keys. In typing ordinary material, one has to use the less efficient left hand more often than the right hand. The strokes for the right and the left hands are of about the ratio of 16 to 21. Besides, the fingers are not used according to their relative capacity, as they might be in a better organized machine. However, after one has learned to typewrite on a standard keyboard, he would probably lose in efficiency if he attempted to learn a new keyboard. If this condition is seriously considered, improvement could be made for those who are beginning to use a typewriter. Most persons are very slow to make a change from the accepted order of things, even when they can understand that their methods are not the best. The one who strives for personal efficiency must constantly force himself to overcome this tendency to inertia. Most of us hunt for ease, rather than efficiency, failing to realize that more ease in the long run will be obtained if we endure a little immediate discomfort while we are improving our methods.

Stimulating Employees. Parallel with the interest in personal efficiency goes the stimulation of employees to improve their output. One cannot expect the workers to do their best unless they are properly stimulated and motivated.

A change has come about, based on our increasing knowledge of psychology, in the application of incentives to stimulate employees. The traditional incentives that have been used have been fear, punishment, and compulsion. These have been shown to be inadequate and to lead to more and more inefficiency. They have given place to the use of methods and devices which encourage initiative, coöperation, loyalty, pride in accomplishment, and love for the work itself.

This change has the support of experimental investigations. Hurlock [1] put four groups of children who were of equal capacity through a course of training in arithmetic for a period of five days. One group were regularly praised for the excellent

[1] Hurlock, E. B., "An Evaluation of Certain Incentives Used in School Work," *Journal of Educational Psychology*, Vol. 16, pp. 145 ff.

quality of their work; the second were regularly reproved for the poor quality of their work; the third group were ignored, although they were permitted to hear the commendation and reproof given to the other groups; and the fourth group were trained in a separate room, being given no praise or reproof themselves and no knowledge of that given to the others. This experiment demonstrated that praise was the most effective incentive. The first group had a final score nearly seventy-five per cent better than the fourth group, about forty per cent better than the second group, and sixty per cent better than the third group. Those who were kept free from any reproof or praise did not improve their work during the course of the five days. The first administration of reproof was about as effective as praise, but the effect soon wore off, whereas praise continually increased efficiency.

LXII. Indirect Influences upon Efficiency

In addition to the effect of motivation, efficiency is influenced by various other factors. Some of these have to do with the condition of the individual, such as the use of drugs; others *have an influence upon his happiness and thus in*directly affect his efficiency. We shall consider each of these.

Effect of Drugs on Efficiency. Almost as far back as we have accurate historical records, man has used drugs in an attempt to adjust his inner life or to enable himself to adjust to his environment. At various times, serious battles have been fought against the use of drugs by those who contend that their effect is deleterious. Recently scientists have endeavored to discover just what is the effect of certain of these drugs on the physiological and intellectual processes of man. While the laboratory tests have been very disappointing to the reformer, it may be well briefly to state the conclusions of these investigators.

1. *Tobacco.* A study of the effects of tobacco was made by Hull. With careful controls, he studied the effect of smoking a pipeful of tobacco on pulse rate, tremor of hand, tapping, muscular fatigue, speed of crossing out *A's*, accuracy of crossing out *A's*, reading reaction time, learning reaction time, speed of adding, accuracy of adding, memory span, and rote learning. Hull concludes that of all these activities, only three show unmistakably the effects of tobacco. Two of these — pulse and tremor — are essentially physiological. The pulse is increased and the hand is less steady. Of the psychological processes, only adding shows a loss in accuracy. The rest show a doubtful influence. In other words, laboratory tests have not shown tobacco to be harmful, and on the other hand, they have not shown it to be a means of definitely improving efficiency.

2. *Alcohol.* Much discussion has been centered about the effect of alcohol on the human being and most investigators, until recently, have been so partisan in their studies that they failed to use adequate controls. The difficulty has been accentuated by the fact that alcohol differs in its effect in proportion to the size of the dose; in small quantities, it may have food value, while in large quantities it is a poison. Furthermore, it has been found to stimulate one set of organs and to depress others; and finally, it has a widely different effect on different individuals. In spite of these difficulties, Dodge and Benedict, and Hollingworth have found fairly consistent results. The results of Hollingworth are especially convincing and conclusive. He administered alcohol in the form of beer, with control doses of beer from which the alcohol had been removed. "In all the mental and motor tests used, the effect of alcohol is to reduce the score. The hand is made less steady; motor coördinations less accurate and rapid; rate of tapping is reduced; the processes of color-naming, naming opposites, and adding are slowed down, and the rate of substitution learn-

ing is less rapid. In pulse rate, which must be considered separately from these mental and motor tests, the effect of alcohol is to produce a positive acceleration." [1]

Do men drink in order to make themselves less efficient? Why do drinkers report that they can do better work when they are partially intoxicated than when sober? The most common reason for drinking is that by this means men find a temporary escape from trouble. In the face of tasks which seem too much for them or mental conflicts which they cannot solve, men take to drink. Whereas one man may forget his trouble in work, another attempts to forget his by the use of a drug which reduces his cerebral activity. The motive for drinking has not been studied by means of laboratory experiment, but there is increasing clinical evidence to support this conclusion.

3. *Other drugs.* Other drugs are taken by men for various reasons. Some of them, such as caffeine, seem to have an immediate stimulating effect. Others, such as morphine and cocaine, are taken to relieve pain. The habit-forming power is especially strong in the latter two, and a person who has once become a morphine addict has very marked and painful symptoms when the drug is not taken. These are called abstinence symptoms and, in some cases, have been known to prove fatal. Such drug habits must be broken by giving the individual gradually diminishing doses.

Such use of narcotic drugs by man can only be understood in terms of his attempt to adjust. If a man feels inefficient, a drug may make him feel efficient for a time. If he is in pain, a drug may remove the pain. If he is in a mental conflict, some drug with a deadening effect may enable him to forget for a time. The best way to treat a drug addict is to discover the motivation behind his habit, and teach him some better way

[1] Hollingworth, H. L., "The Influence of Alcohol," *Journal of Abnormal and Social Psychology,* Vol. 18, pp. 204 ff., and 311 ff.

to adjust. Only in this way can the drug habit be treated with fair hopes of recovery.

Efficiency through Satisfaction. Numerous studies have demonstrated that industrial efficiency is increased through any device or organization which will increase the satisfaction of the worker. Such satisfaction may be brought about by many devices, but five general methods may be enumerated.

1. *Medical care.* The use of medical clinics has proved very effective in increasing the feeling of assurance of workers that, should sickness overtake them, they would be cared for. Recently there has been a movement toward the employment of specialists in mental disorders, so that the mental health of the worker may be safeguarded as well as his physical health. Any such movement is desirable, but it must be recognized that clinical work deals only with the minority of individuals. A person may be mentally and physically in good health and still be dissatisfied. Hence, while clinics are necessary, they do not solve the larger problem of making the entire working force satisfied.

2. *Satisfaction in work.* Various attempts have been made to make the work interesting in itself. Pride in workmanship, competitive devices, sliding wage schemes, beautiful surroundings, music, worker ownership, and many like schemes have been used to make the worker feel that his work is a vital thing of which he may rightfully be proud. In some industries these methods may be used very effectively, but in others the managers feel that these methods are very costly because they run counter to the tendency toward increasing specialization. Such increased specialization automatically makes work in and of itself less interesting and, consequently, the aim to make work attractive must lead to greater and greater artificiality.

3. *Shorten working hours to permit more recreation.* This plan has been sponsored very effectively by Henry Ford. The theory is that efficiency necessarily leads to work that becomes

less interesting in and of itself, and that the only way to satisfy the worker is to shorten his working hours, raise his pay, and permit him to enjoy life. The worker does not expect any fun from his work. He comes to work to do his highly specialized task as efficiently as possible, knowing that he is being well paid for it, and looking forward to the time when he can leave the factory and enjoy life.

4. *Use of machinery to do the most undesirable jobs.* It must be recognized that the Ford philosophy does not attempt to force workers to do unpleasant tasks. Its keynote is the increase of efficiency. To this end, the invention of machines to do the most menial jobs has greatly alleviated the situations which existed in industry half a century ago. While work in the modern factory is monotonous, it is to a great extent not actually distasteful. We have automatic stokers to relieve the sweaty human stoker; we have ditch diggers and steam shovels to relieve the human worker from the use of the old pick and shovel; we have steam hammers, steam saws, conveyors, and a thousand other devices which made man the overseer of a machine instead of a beast of burden. Consequently, while work is becoming more monotonous, it is getting farther and farther removed from the sweat-shop.

5. *Removal of hazards.* With the increased use of machinery comes the increased possibility of accident, with consequent injury to the workmen. Two methods may be used to deal with the problem of accidents. One is to provide mechanical safeguards against accident and the other is to provide workmen with compensation and insurance when they are injured. Both of these are being more and more extensively used. The second, of course, is the more desirable for immediate protection; the former is the goal for which we should strive.

Two English investigators, Collis and Greenwood, made a study of the hazards connected with various professions. They reduced the variables to percentages of hazard as compared with that of a clergyman, calling the latter 100. The relative hazards for the years 1900 and 1910 are given in Table XI. In some of the industries conditions were greatly improved in the ten-year period, suggesting what might be done in others.

TABLE XI. HAZARDS OF INDUSTRIAL WORKERS

(From Poffenberger, A. T., *Applied Psychology*, by courtesy of D. Appleton and Company.)

	1890	*1910*
Clergy	100	100
Agricultural laborers	119	106
Commercial clerks	172	181
Coal-miners	174	164
Bricklayers	188	149
Saddlers and harness-makers	174	166
Cotton-manufacturers	214	183
Wool-and worsted-manufacturers	186	151
Silk-manufacturers	173	162
Hosiery-manufacturers	131	166
Lace-manufacturers	133	174
Carpet-manufacturers	164	145
Tin plate workers	187	152
Chemical workers	262	147
Paper-making	170	153
Shoe-making	173	188
Tailors	186	180
Cabinetmakers	184	179
Printers	206	174
Bookbinders	199	179

Conclusion. Motivation is a very important factor in human behavior. Motive may, by analysis, be reduced to a few fundamental drives, such as hunger, sex, freedom of movement, and satisfaction of organic needs; but in the actual behavior of the human being in society, they become very complex and appear in various forms. Consequently, the study of human motivation must deal with complex human sentiments, rather than with simple urges. A man gets hungry, but he wants to eat, not to satisfy his appetite alone, but to satisfy a multitude of esthetic sentiments which he has learned. The same is true of all other desires.

Personal and industrial efficiency depends upon the operation of these various motives in connection with various situations in which the individual finds himself. By organizing work, either for ourselves or for those in our employ, the force of motives may be definitely controlled.

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CHAPTER XV

SLEEP, DREAMS, AND HYPNOSIS

LXIII. Sleep

Periodically a man goes into a state in which impressions fail to gain entrance through his sense organs, the tonus of his body decreases, he becomes relatively inactive, and his mental processes take on very unusual forms which are known as dreams. While this condition, from a physiological standpoint, is considered simply as a period of recuperation, it presents some complications in relation to our mental activity which form an interesting chapter in psychology.

Physiology of Sleep. In sleep there is a partial or complete loss of consciousness with which go the following observed conditions quoted from Howell: [1]

1. *Respiratory changes.* "The respirations become slower and deeper, and the costal respiration (respiration by elevation of the ribs) predominates over the abdominal or diaphragmatic respiration, as compared with the waking condition. The respiratory movements, also, frequently show a tendency to become periodic, that is, to increase and decrease regularly in groups. . . . The expiration is frequently shorter and more audible than in the respirations of the waking hours."

2. *Changes in tonus.* "The eyeballs roll upward and outward and the pupil is constricted. . . . The knee-kick decreases or disappears entirely during sleep."

3. *Changes in secretions.* "Some of the constant secretions are diminished in amount, as, for instance, the urine, the tears,

[1] Howell, Wm. H., *Physiology*, p. 255. Saunders, 1921.

and the secretion of the mucous glands in the nasal and pharyngeal membrane. One of the familiar signs of a sleepy condition is the dryness of the surface of the eyes, a condition that leads to the rubbing of the eyes. It is sometimes stated that the digestive secretions are diminished during sleep, but the statement does not seem to rest upon satisfactory observations, and may be doubted."

4. *Circulatory changes.* "The pulse rate decreases during sleep; the blood pressure falls somewhat."

The common factor in all these changes is that the activities of the sleeping organism are for the most part those essential for the maintenance of life. Conduct which is specifically a reaction to environmental situations is largely held in abeyance.

Psychological Factors in Sleep. "In much everyday discussion, the word 'sleep' is used precisely as it should be used in scientific discourse. For example, consider a baseball game in which a runner is playing rather far off second base, in readiness to steal third at the first opportunity. The pitcher unexpectedly throws to shortstop; whereupon the runner, becoming confused, makes for the wrong base. As he is put out, the fans exclaim, 'Sound asleep!' Generalizing, we say that an organism is 'awake' to those parts of the environment to which it is reacting *specifically,* and in a manner which tends to preserve it; we call it 'asleep' to those objects to which it does not specifically react." [1]

This popular conception can further be elaborated to distinguish between a person who is in actual sleep and one who is awake. If we stimulate a person and he fails to respond to that stimulus, we judge him to be asleep even though he may be relatively active in other respects. Persons may walk in their sleep and do elaborate acts, but if they fail to respond

[1] Johnson, H. M., "Is Sleep a Vicious Habit?" *Harper's Magazine,* November, 1928, pp. 2–3.

to specific stimuli, we judge them to be asleep and call the phenomenon a somnambulistic or sleep-walking episode. But this distinction is only relative because there are persons who do react to their environment, go from place to place, carry on business, and seem to be alert and wide awake in every respect, but who, after a period, may wake up with no memory of all the varied activities of the preceding weeks or months. These periods of wanderings are called *fugues*. These persons were asleep to parts of their preceding existence and when they "wake up," they forget all that happened in the period of wandering. We may say that these persons were awake. To all outward appearances they were, but to certain parts of their lives and to those external situations which would inevitably remind them of these portions, they were asleep.

In still another sense, parts of our bodies may be asleep while other parts are awake. This situation may occur when we maintain a certain posture for so long a time that a part becomes numb. We say our foot or hand is "asleep." It is incapable of receiving impressions from the outside or from the muscles and skin. By means of a local anesthetic, we may put our leg or arm or other portion of our bodies to sleep.

The mental life of the sleeper is not entirely inactive. In certain types of sleep, parts of his mental life may be very active. *From a psychological standpoint, sleep may be considered as a positive resistance against certain types of activity.* A person partly asleep is unresponsive to a limited group of mental stimuli; a person deeply asleep is unresponsive to a greater portion of the things which would stimulate intellectual activity.

Activity during Sleep. Although there is little specific activity during sleep, recent experiments have demonstrated that the actual movements of the sleeper occur with greater frequency than was formerly supposed. Professor Johnson,[1]

[1] *Loc. cit.*, pp. 7–9.

by means of a recording apparatus attached to the bed of the sleeper, was able to get a graphic record of any movement of the sleeper, either of his whole body or of a limited part. His most important findings may be summarized as follows:

1. *Children move during sleep more often than adults.* On the average, a healthy child moves every seven and one-half minutes during his sleep. The least motile child moves on the average every ten minutes, and the most motile child every five minutes. This indicates that movement during sleep is of greater frequency than most persons have supposed.

2. *Fatigue of a moderate amount increases motility during sleep.* Both adults and children are more restless when they go to bed tired.

3. *Each person has a characteristic rhythm which is not easily broken.* When two persons occupy separate beds, placed side by side, they stir and rest independently of each other. "If two persons desire to rest undisturbed by each other's movements in sleep, this can be done by using separate beds. Separate rooms are quite unnecessary unless one person is noisy when asleep or unless he walks about or talks while he is awake."

4. *It appears that lights and noises, in themselves, have but little effect on sleep.* Once they arouse us, light and noise may interfere with a return to sleep. Johnson's results show that they are not important interrupters unless they are intense, novel, or frequently repeated; or unless we have trained ourselves to respond to them. His records show that blind and deaf persons have the same frequency of movements as persons with keen sense receptors, a condition which would not obtain were sense impressions important factors in causing movements in sleep.

These movements are all the results of automatic attempts on the part of the organism to remove sources of irritation which would tend to disturb sleep. In other words, sleep is not merely a passive condition; it is an active attempt to maintain a condition in which one does not react to external stimuli.

Insomnia. If this conclusion is sound, it throws light on another problem; namely, the differences in individuals in the ease with which they can relax and go to sleep, as well as the differences which the same individuals experience at different times. Some persons suffer from insomnia. In spite of all their efforts, they find themselves unable to sleep, and the harder they try, the more sleep seems to flee from them. This condition is probably due to an inability to ignore environmental stimuli. Such a condition may result because one has been too much excited by the events of waking life, or because he has failed to learn the habit of relaxation. To attempt to sleep is simply to aggravate the difficulty and to keep in touch with external events. The tricks adopted to induce sleep substantiate this theory. One may "count sheep"; read a monotonous and uninteresting book; listen to a monotonous sound; or encourage free association which is commonly known as "wool-gathering." All these things encourage inactivity. They are means of producing immobility of mental and physical processes. When these factors lead to actual immobility lasting over an interval of five minutes or more, we have sleep. Johnson has adopted this criterion to determine when a person is asleep. He says: "We arbitrarily date the beginning of sleep from the beginning of the first stretch of immotility which exceeds five minutes." [1]

LXIV. Dreams

Just as sleep involves characteristic differences in the kind of bodily activity which predominates in the waking state, so there are characteristic differences in the kind of neural activity during sleep, when compared with the intellectual processes that may be observed when one is awake.

[1] *Loc. cit.*

Why Do We Dream? It is quite likely that mental activity during sleep may be of two sorts. One is the chance interplay of neural currents which takes place when there is a lack of central control. This type of thing takes place when one has what is called an *occupational delirium.* The activities which have occupied one in the waking state have stimulated certain neural pathways so that their activity continues after sleep sets in. For example, after driving a car all day, one may, in an abortive manner, continue the driving in his sleep. If one is worried about some event during the day, all the phases of this problem continue to dominate the mental life of the dreamer.

On the other hand, there is evidence to indicate that the dreamer makes automatic attempts to keep in the background thoughts which would result in awakening him, just as he resists physical irritations that would disturb his sleep. This is the second sort of mental activity which may take place during sleep.

Let us illustrate how this operates. A business man is harassed by a problem he cannot solve. During all the day there surge through his mind various possible solutions which he rejects for one reason or another, only to have them come up again and again in his frantic search for a suitable solution. Finally, at the close of the day, having failed to solve his problem, he seeks a reprieve through sleep, but in vain, for the problem will not leave his fevered brain. As he is about to go to sleep, the problem comes back in full vigor, clamoring for a solution. If he could only solve it, he could relax! Finally, he does manage to throw it off long enough to go into an initial period of intellectual and physiological immotility. Then the problem comes back to disturb him in the same manner that the physical irritations tend to wake him. He can throw off the physical irritations by turning over, and he may attempt to throw off the intellectual irritations in the same manner, but a bodily roll will not remove the burdens from one's mind. Another device comes to his aid. He weaves the problem into a distorted intellectual product and dreams a solution. In other words, *a dream is a device to enable the dreamer to avoid reacting specifically to an intellectual stimulus.*

The solution which the dream offers may not be a feasible solution; it is merely a solution designed to enable the person to continue to sleep without giving intelligent thought to the intellectual stimulus which provokes the dream. It would be a mistake to credit our dream life with solving rationally some intricate problem. We might remember a dream solution which would prove the most desirable answer to our problem, but this does not mean that dream solutions are always best. In such an instance, it is likely that the dream solution is merely a reverberation of a solution which has already presented itself in our waking state.

Dreams as Personality Indicators. Freud has evolved the theory that all dreams are expressions of unfulfilled wishes of one sort or another. It is easy to see why many dreams would express unfulfilled wishes. If one has an unsolved problem, it is quite likely that some solution may have presented itself in the form of a wish that he might act in a certain manner. Because of personal or social ideals or conventions one has to discard many possible reactions. In the dream, such a rejected solution, a rejected wish, could come as the compromise solution; the solution designed to enable us to refrain from reacting specifically and with deliberation to our problem.

If we study our dreams, we can learn two sorts of things about ourselves. We can tell the nature of the problems which have given us the most concern during the day. These are the ones that will most insistently intrude upon our sleep. Secondly, we can get an indication of the type of solution which has suggested itself to us. Sometimes these solutions may be in the form of subtle wishes which we rejected with but fleeting consideration when we were awake.

Dreams Have No Prophetic Value. It should be mentioned that scientific studies of sleep and dreams give absolutely no support to the many superstitions which have been current that dreams have prophetic value. We may, of course, do at a later time what a dream indicates we wanted to do, and thus the dream may be fulfilled. But this is quite different from contending that there is any causal connection between our dreams and an earthquake, fire, rainstorm, train wreck, death of a friend, or the like. Dreams may tell us something about the mental life of the dreamer, but they have no virtue to predict forthcoming events.

Types of Dreams. Dreams take on multitudinous forms, and one cannot hope to devise any complete or adequate classification. For convenience, however, some general types may be differentiated.

1. *Free-association dreams.* The occupational delirium, to which we have already referred, belongs in this class. The associations follow each other in random sequence with no control on the part of the dreamer except that furnished by the important place occupied by certain associations in the immediate past. It is quite likely that most dreams are of this sort. They are composed of a meaningless jumble which is so incoherent that most of the elements are immediately forgotten. What incidental memory does remain seems to have little significance.

2. *Wish-fulfilling dreams.* The popular conception of dreams emphasizes this type of dream. We regard the land of dreams as the place where we obtain our heart's desire. We dream about our ambitions and ideals in life, and if our sleeping dreams do not satisfy our appetite for this method of getting what we want, we may fall into daydreams. Clear-cut,

wish-fulfilling dreams are very characteristic of childhood, as any study of children's dreams will show.

As one grows older, there are many things for which one might wish, but some moral or intellectual repugnance may prevent him from openly acknowledging that he has any such desire. Such wishes may take the form of a dream in which the actual wish is disguised. Many dreams have been studied, especially by the psychoanalysts, in the light of this theory and have, to a certain extent, corroborated the view that in a dream the wish may be disguised. A study of such dreams often indicates the underlying impulses that actuate one. Some psychologists have expressed a skeptical attitude toward interpreting dreams in this fashion. The reason for this skepticism lies in the fact that the psychoanalysts have tended to emphasize one type of wish rather exclusively; namely, wishes connected with the sexual life of the dreamer. If we keep before us the purpose of the dream as we have outlined it, this need give us no difficulty. The dream is a means of rejecting insistent stimuli which call for a solution through intellectual activity. If dreaming a direct solution provides a ready rejection, the dreamer will dream that he is getting his wish. If getting such a wish violates the moral codes of the sleeper, he will be likely to dream that he is gratifying his wishes only in a disguised manner; that is, he dreams a compromise which will give him relief and, at the same time, not violate his moral ideals. A disguised wish-fulfilling dream, in addition to indicating the suppressed wishes of the dreamer, will also disclose the moral ideals which led to their suppression. Unfortunately, this latter use of dream interpretation has been very much ignored. We take more delight in hunting for the scandalous things in life than the worthy elements.

3. *Fear dreams.* One of the most persistent disturbers of waking life is fear. A person who is dominated by a wish may temporarily dispel the restlessness which accompanies a lack

of achievement; he may relax with the hope that on the morrow he will have better fortune and come nearer to the fulfillment of his wish. Not so with a fear. One harassed by a fear often finds it impossible to relax; he cannot tell himself that he has partially adjusted to his fear; he must be on the alert or some dire fate will overtake him. How natural, then, that a great many dreams should deal with fears. Furthermore, in spite of the dream, the fears insistently encroach on sleep and finally wake the sleeper. The person awakened because of a fear will readily remember the dream which came as an attempt to maintain sleep. Hence, a large number of remembered dreams are fear dreams.

Fear dreams may also disguise the real fear which actuated them, so that much light can be thrown on the life of a dreamer if he can determine the real fear which causes his restlessness and inability to relax. If one is subject to fearful dreams, his best course is to deal frankly with his fears until they disappear, instead of frantically attempting to get into a dreamless sleep.

4. *Allegorical dreams.* Dreams are very likely to take the form of picture symbols. When these are brief and disconnected, we may get a suggestion of the problems which confront the dreamer. In some instances, the dream becomes a bit of artistic work and takes the form of a fine allegory. The meaning of such dreams is rather apparent if one does not try to give the symbols literal interpretation.

A woman once told the writer that all her life, she has been having dreams which have fitted into a complete figurative story of her whole life. This dream story took the form of traveling over vast expanses of territory. If she had a particularly glorious experience, she would dream of passing through the most beautiful country, different items of beauty representing the different specific good things that were happening to her. When she had difficulties, she would dream of passing through rough mountainous country, and going over bridges that were about to be washed away and pitch her into the raging waters beneath. Through all these journeys, she always pictured a distant peak toward which she was journeying. In some dreams, the peak would stand out glorious and clear, and in others it seemed to recede and be hidden by the mists. These dreams did not portend what was going to happen to her. They had no prophetic significance. But they did show her attitude toward the experiences she was having.[1]

LXV. Efficient Use of Sleep

Since sleep occupies at least one third of life, most persons are concerned in making it contribute as much as possible to their mental welfare. Our discussion of the principles involved in sleep and dreams suggests the following practical rules which may be applied to make sleep function effectively.

Learn to Relax. Sleep is essentially relaxation, mental and physical. Relaxation means ceasing to respond actively to the stimuli which insistently play upon us. It is a habit, which may be learned if one approaches it properly. The one who suffers from insomnia usually has a fear that he cannot sleep. This fear in itself causes tension, and thus frustrates the very purpose it is supposed to serve. To work hard should not involve inability to lay aside that work for a period of time. The harder one works, the more justification he has to say to himself, "I have worked hard and now I am going to take some time for rest. After I have rested, I shall go at it again."

Sleep Enough to Keep Fit. Most persons have the theory that sleeping is a nuisance, and attempt to get along with as little of it as possible. This very attitude tends to make sleep less beneficial because it carries with it a feeling of tension and a fear that one may sleep too long. The value of sleep cannot be measured by the length of time one spends

[1] Morgan, John J. B., and Gilliland, A. R., *An Introduction to Psychology,* pp. 271–272. Copyright, 1927, by The Macmillan Company.

in bed. The studies in motility during sleep suggest that one gains more by sheer abandon when he retires, than he will if he goes to bed with a restless feeling that he is wasting time or with a fear that he may not sleep.

Study Dreams to Understand Mental Life. Dreams, when frankly studied, will tell a person much about himself. They should not be ignored or merely regarded as evidence of unsound sleep. They should be studied as a means to a better understanding of one's self.

LXVI. Hypnosis

Hypnosis is essentially a sleep. The person goes to sleep — that is, becomes unresponsive to external stimuli — but remains responsive to the actions and words of the person who told him to sleep. There is no mystery in hypnotic sleep; it is simply another form of sleeping " with one eye open." The hypnotized is asleep to his whole environment, with the exception of the hypnotist, but he is quite responsive to this one personality.

Nature of Hypnosis. We have seen that sleep is essentially an active resistance against responding to certain specific stimuli. If this resistance is general, the person is said to be in a deep sleep; if it is partial, he is in a light sleep. But a person may be in a deep sleep with reference to certain phases of his environment and awake to other phases. Witness a mother who sleeps very soundly, but is alert to the slightest disturbance on the part of her baby. She goes to sleep, but with the reservation that she will continue to be alert to her child. We are all familiar with illustrations of this kind of sleep. Hypnosis is a sleep of this sort.

Hypnotism Based on Suggestibility. The method by means of which a person is hypnotized is somewhat as follows. The hypnotist has the subject gaze at a fixed point, instructs him to relax and think of nothing except the fact that he is going to sleep, tells him he is getting sleepy, that his eyelids are getting heavy and are closing, and that he is sound asleep. These statements are repeated over and over until the subject actually does close his eyes and is, to all appearances, asleep. In this condition, the person may do things that the hypnotist tells him to do; he responds to the hypnotist but not to other persons.

When a person obeys the hypnotist, goes to sleep, and follows the commands of the hypnotist when asleep, we say he is suggestible. What do we mean by that? Why is he willing to do what he is told? It is well known that a person cannot be hypnotized if he is unwilling to be. Willingness to obey is a large factor in suggestibility and is probably the only factor of significance. Some persons, influenced by the superstition under which hypnotism throve, believe that this willingness to obey is evidence of some mysterious power on the part of the hypnotist. Indeed, it was once thought that some such influence radiated from certain persons, and was referred to as animal magnetism. We now know that there is no such force or anything resembling it. Obedience is nothing more than a learned attitude. In our contacts with others we come to trust some and to distrust others. From some we will take advice and suggestions, but from the advice of others we flee as from a plague. Our judgments of others in this respect are often faulty, but, nevertheless, we continue to make them.

Furthermore, some persons develop the habit of placing implicit trust and confidence in great numbers of people. Others scrutinize every person with great care, are very suspicious, and seldom take any suggestion without many reservations. In other words, we differ in the degree to which we respond to the influence of others and also in the number of persons by whom we permit ourselves to be influenced. If we have great confidence in another person, we accept suggestions from him. If we have no confidence in a person, we will not accept suggestions from him. Whether we are habitually resistive or suggestible is dependent upon the experiences we have had with others. If, when we have trusted people, we have benefited thereby, we tend to maintain the attitude of trust. If, having trusted others, we find ourselves betrayed, we tend to maintain the attitude of negativism or distrust.

This is the essential nature of the suggestibility which produces hypnosis. The subject must have confidence in the hypnotist; he must believe that the hypnotist's commands are to be obeyed, and be willing to obey them implicitly. When he reaches this stage, he may be hypnotized by that person. Those persons who have a negativistic attitude toward all people (and there are such persons) cannot be hypnotized by anybody. All this goes to show that hypnotism is no display of peculiar force by the hypnotist, but depends solely on the attitude of the subject. A good hypnotist is one who has learned how to gain the confidence of people.

Is it wise to take suggestions from other people? The answer that the reader gives to this question will, to a certain extent, indicate whether he is suggestible or negativistic. The balanced man takes suggestions from some persons and refuses to take them from others. He tries to use a certain amount of discretion. One should not take suggestions as to his investments from his barber, nor ask his bootblack for whom he should vote, nor request a headache remedy from the first person he meets on the street. Nor, on the other hand, should he scorn all advice from broker, banker, physician, or personal friend, each in his legitimate field. By the same token, one should not ask to be hypnotized by every person he meets; but, on the other hand, he has not done something to his permanent injury, should he permit himself to be hypnotized by some one he trusts.

All stories to the effect that a person may be hypnotized against his will, may be influenced by another who is miles distant, may be made to do immoral things which are against his ideals, or may permit himself to be victimized by hypnotists who sneak around unobserved are sheer nonsense.

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CHAPTER XVI

MENTAL HEALTH

LXVII. Knowledge of Psychology Fosters Rational Adjustments

When we study the mental lives of those around us, we are sure to observe that there are great differences in the success that different persons achieve in adjusting mentally. There are persons who seem perfectly normal; there are those who are queer; those who are hard to get along with; those who become vicious and cannot be trusted; and those who become so mentally unbalanced that they have to be confined in a hospital. To understand all the factors which lie behind these differences would require a great amount of study, but we can sketch briefly here some of the main causes of these variations, in the interest of helping the student to formulate some principles which have been found essential to the maintenance of mental health.

Adjusting to Our External Environment. In much of our early life we are occupied with learning how to adjust to the environment in which we find ourselves. Such an adjustment is not always simple and easy. We are stimulated by one set of conditions to do one thing and by another set to do another, a situation which precipitates a conflict. There may be a bit of candy which we want to eat and, at the same time, a larger person who says, "No, no." Further, we may have learned that if we take the candy when this person is around, we encounter an unpleasant situation, such as a slap or some other disagreeable stimulus. Counter stimuli are continually present, and a large part of our lives is taken up with a selection from these conflicting stimuli. Our actual response depends, of course, upon our previous experiences.

A person may learn continually to do the things which ng him into conflict with certain forces in the outside world. may be the bad boy in school; he may be the criminal ien he becomes an adult. While such a condition of maladjustment to the moral and social restrictions makes life unpleasant for the one who seems unable to accept social inhibitions, it does not lead to a mental breakdown. It is not this type of thing which leads a man to an institution for the insane. Mental balance is not upset by an out-and-out fight with one's environment.

Adjusting to Our Internal Environment. Our major adjustments are not to social restrictions. To be sure, some persons conform only because they know they will be in conflict with the law if they do not, but that is simply a continuation of a childish attitude. The normal individual, through experience, builds up certain sentiments or emotional attitudes towards life, and these attitudes take the place of the external restraints which control the child.

For example, a child may refrain from taking the candy because he is afraid of getting his fingers slapped; the adult should learn to refrain from taking it because it is stealing. Now, the inhibition against stealing is an internal attitude which takes the place of external force. A person restrained by such an attitude (or ideal, as it is often called) is not in conflict with the law, but with himself. Part of his being wants the candy and another part will not let him take it.

Furthermore, these internal conflicts need not always be an imp... fighting against an ideal. There may be two attitudes, each in itself a perfectly worthy one. Witness the conflict a young man may have between his sentiment of love for his home and his ideal of an education which would take him away to college. Both are worthy, but in conflict can lead to a tremendous mental battle.

Conflicts between different phases of our mental life are the order of the day and are not to be shunned or viewed with disapproval. The normal man must face these things all the time and adjust to them. Normal mental life is just this resolute and conscious facing and adjusting of each issue as it arises. What leads to mental disturbance is the failure to face each issue as it arises. The keynote to mental balance is: *Face each issue and adjust it as it arises.*

Adjustment may lead to one of three consequences. One horn of the dilemma may be accepted and the other totally rejected; the other horn may be accepted; or there may be a compromise between the two points of issue. There is a false notion that the latter in itself indicates a lack of mental balance. This is not so. Often a compromise is the logical procedure, and where one accepts a compromise deliberately, as his best solution to the problem, he is making a rational and wholesome reaction. The cause of mental disorder is *failure to face the issue squarely.*

But why should a person fail to face a conflict squarely? Because, in many instances, such a situation is painful, and rather than prolong the pain, a person escapes it as best he can by adopting what have been called in psychology *defense mechanisms,* or *defense reactions.* A defense reaction is a means of getting rid of a conflict by some means other than a real settlement of the points at issue. The person is defending himself against the pain of conflict, and not against any specific issue; and that is what makes the trouble.

The way in which a defense operates will become clear if we give a specific illustration. A young man complained that his mental processes were not functioning properly; that he was losing his memory; that he could not think clearly; that life had taken on a different coloring; and that things no longer looked bright to him. He said he was afraid that he was losing his mind. Tests showed that he was not losing his memory, that he did mental problems as well as ever, and that these things about which he complained were not real troubles. Now the question is: "Why would anyone develop such a story when it is without foundation?" If our statement about a mental conflict is valid, the questions to ask about this man are: "What do these symptoms help him to hide? Why is he defending himself, and against what?"

Investigation showed that this boy had a great ambition to be a writer; that he had repeatedly tried to write, but that all his attempts had met with failure and his manuscripts always came back from the editors rejected. It was easier for him to say that his mind was going to pieces, and thus give himself a legitimate reason for abandoning his aspirations, than to admit that he had no ability. He could gain sympathy from his friends if he had a mental breakdown, but not if he had always lacked ability, particularly when he had boasted about his literary skill. So the disorder was an attempt to disguise a feeling of failure.

But there was still more in this case. This boy was unusually short in stature. He had been ridiculed because of his size and had been forced to admit that he was inferior physically. He was led to fear that, because of this physical inferiority, he would always be an outcast socially. Without quite realizing why, he had taken up literary pursuits in order to demonstrate that he could be a social success. So we see, in the last analysis, his problem was not to adjust to his supposed lack of memory or failing mental powers, but to adjust to his real difficulty — namely, his physical inferiority.

Forms of Defense Mechanisms. With this sketch of the principle involved in defense reactions, let us consider some other forms.

1. *Excess activity.* Excess activity may be used in adjusting

both to external difficulties and to internal ones. An example of the former is when one is interrupted in a conversation by the appearance of the one about whom he is talking. There is a tendency to talk much faster about any irrelevant thing which presents itself. The defensive nature of this chatter is obvious to any observer who knows the significance of such things.

The greater significance of excess activity is seen in its use to escape from some internal problem. When one cannot decide an issue, he can temporarily forget its existence by busying himself in some totally different activity. This principle has been used with some success in the treatment of patients in institutions for the insane. As long as they can be kept busy, they are able to think less of their own troubles. (We have discussed the operation of this principle in Section LIX, Chapter XIV.) The difficulty with this defense is that in spite of the work, the problem returns. This tends to make the person work still harder in order to escape. There then ensues a wild race, an attempt to keep busier and busier to keep away from the trouble. If this goes to an extreme, the individual may finally succumb to what appears to be overwork. But in such a case, the real trouble is not that the person worked too hard, but that in spite of the fact that he worked hard, he was not able to keep busy enough to overcome his mental conflict.

Another difficulty with this defense is that, in most instances, there will come a time when the task which one has started is finished. The completion of work, instead of bringing satisfaction and needed rest, brings only an increase in the severity of the mental battle and the person dreads the time when he can finish his work. This explains the queer situation which one may observe of a person working feverishly and well, until he nears the end of his immediate task; whereupon he gets panicky and breaks.

If a person has a feverish urge to work, it is well, from the mental health standpoint, to endeavor to find out why he has this urge, rather than to preach moderation in work to him.

2. *Insufficient activity.* Other persons may do quite the opposite of working hard. They may give up, deciding that the best way to settle a conflict is to do nothing. This becomes especially pernicious if such inactivity is accompanied by a tendency to keep away from others. It can readily be seen why these two tend to go together. Most of our mental difficulties are concerned with other persons, those who have made unsolvable problems for us. Furthermore, when we have some difficulty, others are likely to try to adjust things for us, often in a way which we do not want. If this happens, one may tend to turn away from people, remain passive, and spend his time in reviewing his troubles in his own mind.

This is a most serious defense reaction. After all, it is better for a person to attempt some sort of adjustment, even if he makes a mistake, than to refuse to adjust at all. So, if one had to take his choice between doing too much and doing too little in his efforts to adjust, he had better choose the former. If one is lost in a wilderness, he may get out if he keeps moving, but he has no chance at all if he simply stops moving.

3. *Fears.* Fear is a biological defense mechanism, a means of defending the individual against danger. The first reaction to an external danger, or thwarting, is to fight. It is only when fighting fails in the accomplishment of its purpose, the removal of the harmful object, that fear stimulates the individual to remove himself. From the standpoint of mental hygiene, fears are undesirable because in many instances they make an individual retire from a conflict before he has attempted to adjust it, and because the fears become attached, through conditioning, to objects and situations where they have no proper place. These displacements of emotions, as

they are called, are the most serious type of maladjustment because they defy rational treatment. If a person says he is afraid of some trivial thing, such as rubber, lightning, dirt, open places, and the like, and, in the same breath, tells you he knows it is silly, you can rest assured he is not really afraid of the thing about which he is talking, but that this is a substitute for some other fear which really is the object of his emotional reaction. This displacement of fear is a defense reaction, a means of disguising the real object of fear. The only way to correct such a fear is to determine the object or issue that the person really fears, and deal with it.

Having found the real source of a fear, how can it be dealt with? Experience has taught most of us that familiarity is the best way to overcome fear of an object. There is another method which, in a crisis, is still better. If the emotion of fear can be turned into another type, such as anger or amusement, a crisis may be averted. For example, a professor of chemistry recommends this plan, which he has found very successful. If some one burns himself with a chemical, or has some similar accident in his laboratory, the professor has found that if he expresses too much sympathy, the person may very easily faint, or at least arouse fear in the other students. Consequently, when a student has an accident, the professor scolds him for his awkwardness and tells him that it was all his own fault. This makes the student so angry that the fear disappears and the crisis is averted.

An illustration will show how ridicule or joking can counteract fear. An assistant in a chemical laboratory, while attempting to pour some acid into a container, spilled the acid over himself. He ran out of the room in a panic, yelling that he was burned, that he would die. The head of the laboratory grabbed him and placed him at once under an emergency shower. The assistant continued to yell; whereupon the laboratory head said, "Just look at your clothes! Your skin will heal up, but look at your clothes; they are ruined!" The panic at once subsided.

These principles can be applied, not only in our dealings with others, but with ourselves. An unpleasant emotion, once begun, is likely to be fostered and encouraged by dwelling on it. Let it shift to another less serious one, and mental health is assured. A good principle is to train ourselves to see the humor in life. We can see the humor in things that others take too seriously; so why not see the humor in our own situations and save ourselves from agony?

4. *Compensation.* Compensation is a very common defense mechanism. Generally it takes the form of emphasizing one characteristic in an attempt to make appear insignificant another characteristic in which a person may happen to be, or fears he is, deficient. The trait to be emphasized may be chosen at random, but in many cases it is the opposite of that which we wish to cover. Probably the best distinguishing mark of this mechanism is that its victim usually goes to extremes. It might almost be stated as a principle that when a person is observed doing anything to an unwarranted extreme, he is compensating. The fact that his whole attention is given to escaping the manifestation of some trait which is undesirable makes him lose his perspective, so that he does not realize that he is going to extremes. A person who is afraid that he may be dishonest will appear extremely honest. One who is physically inferior may be a bully, may become over-intellectual, or may become a health faddist. One who has a fear that he may be selfish will go to the extreme of being unselfish and be so painfully generous that he annoys all those around him. One with a fear that he is not doing well socially may overdo his attempts to develop social contacts.

The fact that a person is compensating need not be taken as a direct implication that he is either in bad mental health or that some severe disorder will overtake him. If one succeeds in gaining excellence in some activity, when actuated by compensation, it may be to his credit. The danger comes when one selects some form of compensation which is detrimental to his own interests, or when he fails in spite of all his extra efforts. The former leads to social ostracism and the latter to despair.

Compensation, to be a worth-while reaction, should be carried out with complete awareness of why one is following the interests which he is. It is dangerous when one does not realize why he is acting in the manner that the compensation dictates. Here, again, the condition of mental balance is dependent upon one's willingness to face squarely the problem which confronts him.

5. *Rationalizations*. One of the most subtle ways of escaping a difficulty is to reason it away. This process has been called *rationalization*. It consists of using what appears to be a logical process, when one is simply inventing excuses of a more or less elaborate sort.

This mechanism can begin in a very minor way and insidiously grow to be quite striking. For example, a young man may fail to accomplish what he had hoped for. Common sense would suggest to him that the fault might be in himself: he might be incompetent; he might have insufficient training; he might have some traits which worked to his disadvantage; or other possibilities might suggest themselves. None of these is very welcome, however, and it is much easier to hunt for explanations which do not involve any unpleasant admissions of deficiencies. Consequently, if one can say that some fellow worker is plotting against one, a better feeling is engendered and one maintains his self-respect. This looks trivial, but once started, the defense may grow unwittingly until it is very pernicious. There is a definite mental disease which begins in just this way and such defenses are built up until the patient has actual delusions that people are all concerned in persecuting him to keep him from succeeding. If the belief that the time of a great number of persons is taken up with plotting against one is actually accepted, the result is so satisfying that the belief is very hard to correct. It certainly would be better to admit incompetence in the beginning, even if one overdid it, than to deceive oneself into believing that failure is due wholly to the machinations of others.

These illustrations of various defense reactions show that where one compromises unconsciously, he is very likely to develop behavior that is not the most desirable. These are symptoms, and they always indicate that the victim has failed to meet some problem of adjustment. The correction of such symptoms requires that the person endeavor to correct the basic conflict.

6. *Sublimation.* In some instances, one cannot make an adjustment of the points of issue even when he has fairly faced them and recognizes their significance. This is particularly true when one has a strong and almost ungovernable impulse to do some particular type of thing and, at the same time, has developed ideals which inhibit such conduct. A compromise may take the form of permitting the undesirable impulse to gain expression in a modified form which will not be harmful to the individual or to society. These valuable indirect expressions of fundamentally undesirable impulses are called *sublimations*.

There is little doubt that many of our fine activities are of such order. A boy whose ungovernable curiosity makes him a prying pest may later transform this impulse into the zest for research that characterizes the man of science. A person with a vicious streak of cruelty might conceivably sublimate such an urge by becoming a surgeon.

Our study of psychology has emphasized the function of our mental organism as a means of adjustment. It is primarily an adjustment to our environment, but it is none the less an adjustment of the various parts of ourselves. Our bodies must work in harmony or there will be trouble. Such harmony means meeting each situation, whether largely dependent on external or internal stimuli, in such a manner as to enable us to make the best possible reaction. We must keep our mental balance and must maintain a harmonious relation to those about us. Lack of mental balance is almost invariably the result of unwillingness to see things as they are. We must teach ourselves to perceive accurately; to evaluate what we perceive; to relate these to our previous experiences retained in the form of memories, habits, or ideals; and to act in the manner which these indicate we should. If our reaction brings us pain, it is evidence that it has not been of the right sort. If such is the case, we have probably ignored some element, and the only sensible thing to do is to do what the child does when he falls and bumps his nose in his efforts to walk — attempt to make a better adjustment next time.

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