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APPLIED PSYCHOLOGY

APPLIED PSYCHOLOGY

ITS PRINCIPLES AND METHODS

BY

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TO
MY COLLEAGUE AND FRIEND
PROFESSOR H. L. HOLLINGWORTH
A PIONEER IN APPLIED PSYCHOLOGY

PREFACE

This book is the successor of *Applied Psychology*, published in 1917 under the joint authorship of H. L. Hollingworth and the present writer. The cordial reception given to that first publication, which passed through a number of printings and two editions, together with the rapid expansion of the field of applied psychology and the growth of its obligations to render practical service, are responsible for the appearance of *Applied Psychology* in a modified and much enlarged form. As Professor Hollingworth's interests have shifted to other fields of research in the intervening years, he has preferred to withdraw from active participation in the revision. His influence, nevertheless, has been potent in determining its character.

The purpose of the earlier book as described in its preface—namely, to present the principal aims, types, and methods of applied psychology, its various fields of endeavor and its outstanding results and accomplishments—is much more difficult to fulfill to-day than it was nine years ago. The year 1917 marked the very beginning of a period of rapid development, with the establishment of the first professorship of applied psychology, the first American journal of applied psychology, and the employment of applied psychologists in factories, schools, courts, hospitals, banks, employment departments and civic enterprises. In the succeeding nine years periodicals devoted exclusively to applied psychology have multiplied in this and foreign countries, institutes of applied psychology have sprung up in America, England, Germany, Spain, and Japan, and practically every university and large

college in the country offers courses in the applications of psychology. Statistics published in 1921 show that over half of the members of the American Psychological Association were engaged in research into the problems of applied psychology.

This rapid expansion has not been without its dangers. The growing demand for the services of a psychologist in solving pressing practical problems has tempted the ill prepared and the charlatan to write and practice in the name of applied psychology. The untrained reader cannot always discriminate between what is sound and what is not and is likely to be misled by the more attractive offerings of unscrupulous persons. The writer hopes that he may contribute something toward the correction of this evil, for he believes that whereas the imposter may flourish under attack, he can be met successfully by making the truth more and more accessible.

It is not possible within the scope of one volume to give a detailed account of all that has been accomplished. Emphasis is laid particularly upon the methods that have demonstrated their practical utility and upon the most outstanding results. The book is designed to meet the needs both of the serious student and of the more casual reader. The former will find in the numerous footnotes an abundance of references leading him into original sources of material and more extended surveys. The latter may neglect these and still get an authentic picture of this interesting and important applied science.

Part I deals with the relationship of the facts of modern dynamic psychology to the personality and competence of the individual, regardless of his or her particular activity. Practical application is made of the facts of original nature, the inheritance of mental traits and capacities, individual differences, the conditions and methods of effective work, learning, and thinking; of the psychological influences of such biological factors as age, growth, sex, and race; of such physio-

logical phenomena as fatigue, rest, sleep, and the influence of drugs; and of such environmental factors as illumination, ventilation, weather, time of day, distractions, and solitude.

Part II presents the applications of psychology to those various major types and fields of occupational activity in which the greatest service can be rendered. These fields include: vocational selection and guidance, entailing a discussion of the function of tests of intelligence and special capacities, tests of character and temperament, and the methods of making judgments of fitness more reliable; business, in which all the devices for the distribution of goods must be adapted to the characteristics of consumer psychology; industry, where production depends primarily upon the psychological factors of speed, economy of effort, satisfaction and good will of the worker; the law, where the concept of human maladjustment as the basis of criminal behavior is rapidly gaining acceptance; medicine, in which some of the earliest applications of psychology were made and in which the concept of distorted human motives has come to play such an important part in the interpretation of disease; and education, whose modern developments rest upon a foundation of psychological principles.

Such a systematic survey as is here attempted necessarily draws upon the work of many investigators. The privilege of using this material is gratefully acknowledged. References to such sources have been given in footnotes throughout the book. The origin of points of view and ideas gathered through many years of contact with the literature and with individuals cannot be so definitely recognized.

A. T. P.

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PART I

**PSYCHOLOGY APPLIED TO
INDIVIDUAL COMPETENCE**

APPLIED PSYCHOLOGY

CHAPTER I

EFFICIENCY AND APPLIED PSYCHOLOGY

EVERY ONE is familiar with the great increase in the popularity of psychology within recent years. The number of books on psychological topics, the number of so-called psychological plays, of references to psychology in the newspapers and magazines, of efficiency bureaus and similar enterprises in the business world, all indicate a remarkable change in the status of psychology. Statistics compiled a few years ago showed that, of all the psychologists in America, over one-half were engaged in some application of psychology.¹

MODERN TENDENCIES IN PSYCHOLOGY

What is the cause of this great popularity? One might surmise that it is due to the fondness of the American people for fads, and that in a few years nothing will be heard of all these applications of psychology to practical life. But there is another reason which seems far more plausible than this. It is the change which has taken place in the attitude of psychologists themselves toward their problems in the last twenty years. If we go back to the time of Aristotle, we find that psychology was of a speculative nature, and that its subject matter was the soul. Each philosopher had his own philosophy and arranged his psychology to suit that.

¹ E. G. Boring, "Statistics of the American Psychological Association in 1920," *Psychological Bulletin*, Vol. XVII (1920), pp. 271 f.

Many centuries later there were attempts at an accurate description of the mind; and the mind consisted of consciousness and nothing more.' Consequently, there was great difference of opinion as to the real nature of the mind. Each man alone could see and examine his own consciousness and no one could dispute what he found. Thus there were possible as many different views of the mind as there were individuals studying it. Many of our psychological problems even to-day are in a state of confusion for the reason that examination of consciousness offers the only source of information at present available. For instance, some psychologists insist that there are no such things as mental images, because they themselves do not find them in their consciousness. Others assert that there are images but that they are of no use, that they are simply accompaniments of the necessary processes, or are by-products of these necessary activities. Others contend that the mental images are absolutely essential to thought and give them a very high place in the mental life. These differences of opinion are probably inevitable so long as the investigations are limited to the study of consciousness.

Such a state of affairs would naturally be unsatisfactory to those who hoped to make psychology a science. There could be no reduction of the findings to laws, so long as these findings differed in the case of each individual, and each was a law unto himself. It was necessary to find another source of information about the mind, which would reveal uniformities among different minds, and permit the formulation of a general human psychology. This source of information was found in the behavior of the individual, which might be taken as a sign of what was going on within the mind. When an individual displayed the same outward signs, made the same bodily movements as oneself in an identical situation, he was assumed to be having the same mental experiences. Among the most helpful signs of mental

activities in human beings are language signs. By this use of analogy the sphere of psychology was extended to include not only all normal human beings, but also the animal kingdom and that of the insane and undeveloped mind, because each of these classes has outward behavior which corresponds in a way to our own and hence can be interpreted as significant of mental activity. But it is well to keep in mind that these objective forms of behavior were first used as aids to the understanding of the inner life and the formulation of the laws of the mind.

The outward signs of mental life, or the behavior of the individual, have gradually come to attract more and more interest, so that at present, in the opinion of some psychologists, they are the most important aspects of psychology. In this way the tables have been turned and consciousness has become an aid to the understanding of behavior, instead of the reverse. In fact, there is a more extreme point of view, among those who call themselves behaviorists. These men ignore consciousness altogether, and declare that no help can be derived therefrom. Psychology then becomes the study of behavior, the study of the situations in which persons find themselves, and the responses which they make to these situations.² It is evident that this kind of study can be made as well on the lowest forms of animal life as on human beings. Indeed, it can be more easily studied in the lowest organisms, where the situations and the responses are most simple, and in this realm the behavior psychologist has done the greater part of his work.

The reason for the great change of emphasis from consciousness to behavior is not alone the difficulty in building up a system of theoretical psychology. It has been due in part to demands of practical life. So far as the latter are concerned, it is the behavior of men that is important ;

² See J. B. Watson, *Psychology* (J. B. Lippincott Co., Philadelphia, 1919).

it is human action and not human consciousness with which one has to deal. Of course, behavior is here used in a broad sense, and includes not only the gross bodily movements but also the class of bodily responses that we call language. A man's whole life consists in a process of adjustment to his environment, a series of responses to situations, of forms of behavior. To be a success or failure means to succeed or to fail to adjust oneself to one's environment. A man who responds to the situations in which he is placed in a *normal* manner, or as other people do, is said to be sane; one who fails to adjust himself in this way is said to be insane or out of his mind.

When analyzed from the practical point of view, all education consists in the development and control of behavior, in training an individual so that he shall react normally when put into certain situations. Special training likewise consists in developing the possibility of reactions to particular situations. The education of a stenographer consists in part in training him to react by certain finger movements when certain characters appear before his eyes, or to make certain marks with a pencil when certain sounds strike his ears. All commercial and business life consists in making reactions to specific situations, and the training is only in preparation for the correct responses when the situations are presented. This point of view may be expressed in the statement that every act of an individual, no matter how complicated it may be, is capable of analysis into the situation or appeal and the reaction or response to it.

One might ask why the change in the point of view of psychology was so long delayed—why the theoretical aspect held sway so long. The answer is, doubtless, that every science must reach a certain stage of maturity before practical applications can be made. Such has been the case with the older sciences of physics and chemistry. The science of psychology is very young in comparison with

these, and doubt has sometimes been expressed as to whether it is yet mature enough to afford safe practical applications.

A psychology constructed from this behavior point of view is called dynamic, or behavior, psychology, and its function may be said to be threefold: (1) to give a knowledge of the general principles of behavior, (2) to find how types of behavior may be acquired, (3) to find how the behavior of an individual in any particular situation may be controlled. To satisfy the first of these demands requires a knowledge of the physiological basis of behavior, and especially of the nervous system which controls behavior; to satisfy the second requires a knowledge of what forms of behavior are inherited from our ancestors, immediate and remote, and how this behavior may be modified; to satisfy the third requires a knowledge of the dependence of behavior upon the factors of attention, perception, memory, association, suggestion, and upon such conditions as health, disease, age, sex, together with the influence of such environmental factors as climate, season, temperature, etc. In short, one's behavior at any time depends upon the integrity of his physiological mechanism, upon his heredity, his education, and upon the present stimulus or the appeal to action.

THE CONTROL OF HUMAN BEHAVIOR

When one considers that all these sets of conditions are variable factors in different individuals, it may appear impossible to predict at any one time just what an individual will do, or to control his actions. A further complication is added in that these factors may vary in relative influence in different situations and with different individuals. Yet in spite of all these varying factors, numerous experiences of daily life prove that the reactions of individuals can be predicted with a fair amount of certainty. The common coincidences in which two people find themselves thinking about

the same thing, or making the same remark, indicate the power of the stimulus to create the same response in different persons. They mean that the three factors in addition to the present stimulus have not been so different that a given stimulus cannot bring forth the predicted response. A so-called association test³ for the diagnosis of various forms of mental abnormality has been constructed on the principle that normal individuals will react in more or less uniform ways, and that any great deviation from these normal forms of action indicates abnormality. One thousand persons were asked to tell the first word that came into their minds when each of a hundred different simple words was read to them. The records were then compiled, showing how the thousand people agreed in their responses to each word. A few of the stimulus words and the responses that were made to them will illustrate the nature of the results. In Table I the first word is the stimulus word, the second is the response and the figures following show the number of persons out of a thousand that gave this particular response.

TABLE I. COMMUNITY OF RESPONSE

<i>Stimulus Word</i>	<i>Response</i>	<i>No. Replies in 1,000</i>
dark	light	427
man	woman	394
soft	hard	365
black	white	339
river	water	393
window	glass	316
Bible	book	338
tobacco	smoke	387
blossom	flower	467
sour	sweet	349
eagle	bird	567
lamp	light	650

³G. H. Kent and A. J. Rosanoff, "A Study of Association in Insanity," *American Journal of Insanity*, Vol. LXVII (1910), pp. 37 ff and 317 ff.

Give the stimulus word *flower* and one can be almost certain that the response will be *rose*, or give the word *table* and just as certainly will the response be *chair*. When one man meets another on the street and extends his hand in greeting, he does it with the certainty that the other will do likewise. When one considers the matter he will find that all social and business life has for its foundation the assumption that the behavior of human beings can be controlled and predicted with great certainty.

DEFINITION AND SCOPE OF APPLIED PSYCHOLOGY

In a general way applied psychology might be defined as the application of the findings of psychology to the affairs of daily life. Münsterberg⁴ has made, in his *Psychotechnik*, a distinction between theoretical psychology, applied psychology and psychotechnics. The first is what is known as pure or general psychology. The second consists in the explanation by psychological laws of past events and the facts of other sciences. For example, the explanation of certain historical movements or historical characters by appeal to psychology, and the application of the laws of psychology to the physics of color would be called applied psychology. Likewise, the application of the laws of mathematics to astronomy or the laws of chemistry to physiology would be applied science. Technics, on the other hand, would be represented by the application of the laws of mathematics to the construction of electrical machines for lighting purposes, or by the application of the laws of chemistry to the making of dyestuffs or medicines. In a similar manner Münsterberg would define psychotechnics as the application of psychology to the solution of practical problems.

⁴H. Münsterberg, *Psychotechnik* (J. A. Barth, Leipzig, 1914).

Such a distinction is a limited one, since every scientific discovery has the possibility of leading to some practical application, so that sooner or later it will determine a course of events in the future and for practical life. The scientific construction of medicines demands that the science of chemistry shall first have been applied to physiological processes. When this has been done, in a given concrete situation, examination will show what is lacking in the human organism, or what mechanism is functioning improperly, and medicines may be administered accordingly. Likewise, the proper blending of color dyes in the dyeing and printing of cloth and in the construction of æsthetic color patterns requires that the psychological laws of color contrast shall first have been applied to the physics of light mixture and the chemistry of dyes. Applied psychology and psychotechnics thus become coextensive.

In the following pages we shall consider the *field of applied psychology to be every situation in which human behavior is involved and where economy of human energy is of practical importance*. This includes much that would be excluded according to Münsterberg's definition. If one wished to subdivide the field further, it could be done according to the kinds of human behavior or according to the activities in which human beings engage. For instance, there might be the applied psychology of medicine, law, business, education, industry, and a hundred others. Obviously, this would be too cumbersome for treatment in detail and would involve much repetition, since many of the different occupations would include essentially the same forms of behavior and be subject to the same conditions. Our plan will be to study first the behavior of the individual and its economy or efficiency without reference to any particular sorts of occupation. Then we will show how these conditions of efficiency may be observed in the various larger and more important fields of human activity.

HISTORY OF APPLIED PSYCHOLOGY

The history of applied psychology may be divided roughly into epochs or stages. One cannot mark off any definite period when it came into existence. In some crude form or other it has probably existed as long as men were able to formulate any laws of the mind, whether these laws were correct or not. But one can mark off four periods more or less clearly up to the present.

1. Long before the time of experimental psychology, persons were accustomed to make use of very vague notions of the workings of the mind in the problems of daily life. The mind was supposed to be subject to the influence of all kinds of outside forces, those of inanimate and animate objects, and consequently people's behavior was influenced by all kinds of superstitions and myths. Breaking mirrors, spilling salt, putting up an umbrella in the house, getting married on Friday, being a member of a party of thirteen, and the like were unlucky factors in one's experience.

That one cannot work so well when tired as when rested, that the memory of one person is better than that of others, that some persons are stupid and others bright, are conclusions that were applied to daily life before they were subjected to scientific test in the laboratory.

2. After experimental psychology had developed and a mass of standard experiments had been accumulated, there was a tendency to apply these experiments directly to other fields, just as physiological and physical experiments were carried over directly into the psychological laboratory at its beginning. This tendency was perhaps most noticeable in education and medicine. For instance, education took over directly the experiments in memory, imagination, attention, etc., and tried to use them in solving educational problems. In the attempt to measure any form of complex activity, the procedure consisted in applying a large number of the

standard laboratory tests to persons of varying ability in the particular activity. Then those tests that were well done by the experts and poorly done by those known to be poor in the work, were considered good tests of this kind of ability. This procedure is still of much value and is used where it has been impossible to analyze some complex form of activity into its elements. In such cases the best that can be done is to proceed in a random fashion in the hope that some tests will be discovered which will serve as indices of particular ability. Such relationships do not necessarily mean that the thing tested is a vital part of the process but for some reason serves as a symptom, in much the same manner that rose spots on the skin serve as a symptom of typhoid fever.

3. The third stage, the one into which applied psychology has just entered, is that in which the practical problems themselves are studied, and the actual situations form the material of the experiment. For example, in order to test the memory of individuals for advertisements of various kinds, the routine memory experiments with simple material are not used, but the tests are made with advertising material in some actual advertising medium, such as a magazine or newspaper. In case one wants to know what is the most economical study period for children of a certain age, he goes into the school and tries various lengths of study periods and measures the results of each for its efficiency.* In studying the psychology of crime, the psychology of the witness or the criminal, one puts an individual into a situation which has similar mental conditions and tests his reactions. But it is not always necessary to put a witness in a

*The following are two examples of such attack upon educational problems: A. I. Gates, "Recitation as a Factor in Memorizing," *Archives of Psychology*, No. 40 (1917); and H. E. Jones, "Experimental Studies of College Teaching," *Archives of Psychology*, No. 68 (1923).

courtroom, or to put a street car motorman on a street car to test him, although the particular forms of behavior must be duplicated. Where analysis of the behavior into lower terms is not possible or convenient this very procedure of trying the individual out in the task may be resorted to as in the two cases cited above. The case of telephone operators will illustrate the other procedure. An attempt was made to pick out good operators by putting them at a dummy keyboard and noting the efficiency of their work. It was found that this was a much less valuable method than to analyze the duties of an operator into their elements and to apply tests for these simpler forms of behavior. Rather simple measures of memory, attention and accuracy of movement served as fairly adequate tests.

4. To this third period must be added a fourth including the type of work begun independently of psychology and under the name of efficiency engineering. It consists mainly of the analysis of various tasks into their essential elements and the adaptation of human behavior to them in such a way as to produce the greatest output with the greatest economy of effort. For instance, a certain series of operations, such as handling machinery, will be photographed with a moving picture machine, or with a stereoscopic camera, and every movement studied. If any movements are found to be superfluous, they must be eliminated. Much of this efficiency research has been accepted as invaluable by the applied psychologist, and in turn the efficiency expert has found that his work has led him into problems which must be referred to the psychologist.

THE CONSERVATION OF HUMAN ENERGY

It may seem strange, when such a great amount of attention and so much money have been expended on perfecting machinery for practical use with a view to economy, that the matter of the human element should have been so long

neglected. When thousands of dollars are spent to increase the efficiency of a certain machine, it seems peculiar that the individual handling the machine should not have been studied just as carefully to bring him to his maximum efficiency. For every machine, no matter how automatic it may be, still depends on the human factor for its management. It seems as though this human factor had been left to care for itself on the assumption that common sense ought to tell a person what is the most economical way to do things. On account of this reliance on common sense many of the tests that are made and the changes recommended for the sake of efficiency are at first sight considered trivial. But any series of operations when carefully examined will demonstrate the fact that common sense does not pick out the most economical methods. In fact, from the nature of the case, it seems that this would be impossible. When one begins to learn any performance, common sense will probably select the method which seems easiest at that time. But at a later stage of the training this method may be an actual drawback to further progress. For instance, if one learns to write on the typewriter without instructions, he is almost sure to use the first finger of each hand and to follow all of his movements with his eyes. But it has been demonstrated by experiment that rapid writing requires that it shall be done by the touch method and with all the fingers. Common sense would not start that way, because progress would be too slow and because the difficulties would seem too great.

Much of the neglect of the human factor in efficiency is due to a failure to realize that a few unnecessary movements permitted in such an activity as sewing, would increase the bodily energy consumed in the course of a day. The following conclusion from an experiment wrongly attributed to the writer will illustrate this point:

" . . . It takes more physical energy to play the 'Evening

Star' on a cello than to shovel four tons of coal. He finds further that a pressure average of three and a half pounds per note is exerted and the total for a three-minute rendition to be nine thousand four hundred and fourteen pounds."

Whether or not this be a correct statement, it serves to emphasize the possibility of great waste of energy from small and unnecessary movements.

A type of work which has been investigated, and which would be considered about as simple as work could possibly be, is that of handling pig-iron, picking up one pig at a time, carrying it a short distance and then dropping it. Yet, by careful analysis of all the movements made, the output of a man in a day's work was increased from about twelve tons to forty-seven tons. More than this, his working hours were reduced, his pay increased two-thirds and he went home each night much less fatigued than when doing one-fourth of the work. Another type of work, namely, shoveling, has been investigated and has yielded just as startling results. A careful analysis of every movement made in the act of shoveling showed that it was inefficient to use the same type of shovel for all kinds of work and that the shoveler could not wisely determine the rate at which he should work. His common sense would not tell him what would be the state of his efficiency at the close of the day, nor whether he was starting too slowly or too rapidly to get the maximum results for the whole day. Attention to factors such as these is said to have increased the output of each man by a huge per cent. One series of tests showed that 140 men could do as much as 500 had previously done, and the wages of each of the 140 were raised.

RECOGNITION OF INDIVIDUAL DIFFERENCES

It has probably occurred to the reader that such increase in efficiency must depend somewhat on the choice of the

right individuals for the particular task. Not every man could carry 48 tons of pig-iron in a day. It is quite true that applied psychology demands that we have means of selecting individuals according to certain standards—in other words, it demands that we study differences among people as well as likenesses. The early work in psychology consisted in developing the laws of behavior and ignoring the exceptions. Applied psychology demands that just as much attention be paid to the exception as to the average—that the personal differences be taken into account. This emphasis on the differences among people is one of the greatest steps in advance toward a real applied psychology. As soon as the attempt is made to fit a man to his job, or to fit the job to the man, his stupidity, slowness, nervousness, aptitudes, etc., must be known. For instance, if a man wants to become a typesetter, he should be tested to see whether his reactions are rapid enough to make him able to compete with others. He may be an individual whose reactions to stimuli are habitually so slow as to disqualify him for certain occupations. A man who wishes to become an aviator must be one whose reactions to changes of position are rapid enough to prevent his machine from turning turtle completely before he can make the movements to right it.

The fundamental fact of applied psychology is that the individual is the unit of action, and all advance in this science must rest upon a knowledge of the laws of individual behavior, and the conditions which affect it. To one who reviews the field of modern business, industry and education, the striking thing is the emphasis that is being placed on the individual rather than the group. It can be seen in education, in the recognition of the fact that the individual should be the real unit rather than the class, although actual practice is limited to an approximation to this ideal; it can be seen in the administration of charity which now consists in the study of individual cases; it can be seen in industry

in the use of the piece work system and reward system, which base pay on what the individual can do; the consideration of the individual in the construction of machinery; the arrangement of hours of labor, rest, vacations; the consideration of the individual in the selection and training of employees.

DIFFICULTIES OF APPLIED PSYCHOLOGY

One of the great difficulties in applied psychology has been the fact that too much has been expected of it, and that it ran the risk of being attracted into fields where it is not prepared to go. In fact, its great popularity has led some venturesome spirits to carry it quite beyond the zone of safety. The problems and situations of daily life are extremely complicated and are influenced by a great many factors. Consequently, great care must be taken that no important factors are overlooked in analysis. Correct results demand an analysis, not only of the task into its elements, but, wherever possible, of the total behavior into its elements. Errors may be due to incompleteness in either of these spheres. One example will suffice to indicate this danger. There is among the results of experimental psychology what is called the curve of forgetting, which shows the rate at which the average mind forgets simple material with the passage of time. It has been found that forgetting goes on very rapidly for a period immediately after the learning, but the rate becomes slower and slower as the time lengthens. This curve of forgetting has been proposed as a basis according to which business houses shall send out their follow-up letters in order to get the maximum effect. Since forgetting is most rapid during the very early stages, a schedule must be arranged by which the letters shall be sent out rather frequently at first and gradually become fewer and fewer as time goes on. Whether such reasoning can be carried over from the laboratory experi-

ments on simple material to the complicated situation of the mail order business, might, of course, depend on many other factors of equally practical importance.

The status of the legitimate applications of psychology undoubtedly suffers through the activities of pseudo-scientists and impostors, who practice under the name of applied psychology, and who do not hesitate to pretend to do, for remuneration, what a trained investigator knows is, at the time, impossible. The degree to which charlatans flourish is clear evidence of the need for what they pretend to give. Psychology differs from the other applied sciences only in the number of such impostors who seek a livelihood from it, for all have their camp followers. The best corrective for such abuses is not so much to engage their champions in battle, but to strive for the advance of knowledge so that the practical needs for adequate human engineering can be legitimately satisfied. Within the last few years have been organized the Psychological Corporation^{*} in the United States and similar institutions in foreign countries, whose purpose is to bring the services of the psychologists to the attention of those who need them and to further in other ways the healthy growth of applied psychology.

^{*} The Psychological Corporation, with headquarters in Grand Central Terminal, New York City, and branches in a number of other important cities, is described as follows:

"The objects and powers of this corporation shall be the advancement of psychology and the promotion of the useful applications of psychology. It shall have power to enter into contracts for the execution of psychological work, to render expert services involving the application of psychology to educational, business, administrative and other problems, and to do all other things, not inconsistent with the law under which this corporation is organized, to advance psychology and to promote its useful applications."

CHAPTER II

THE INFLUENCE OF HEREDITY UPON ACHIEVEMENT

HOWEVER one may choose to take sides on the question as to whether heredity or environment is the more important, it will be agreed that the ultimate basis of all human efficiency is to be found in the physical and mental constitution which one inherits from his ancestors. Life is begun with an inheritance, good or bad, and upon this foundation a career of success or failure is established. There is at present a very active controversy concerning what traits are inherited and what are acquired. Especially under fire is the conception of human instincts, or those tendencies to complex patterns of reaction to specific situations, with the result that it is difficult to outline a series of established facts from which practical applications can be made. The attack upon instincts is supported by two kinds of evidence closely related to each other. The first is derived from systematic observation of the behavior of young infants for periods of days or weeks; and the second arises from the discovery in the so-called "conditioned reflex" of a mechanism of learning which purports to account for rapid learning in the earliest days of life. The paucity of specific reactions that are observed in infants a few hours or a few days old, and the knowledge that behavior may be readily conditioned, have encouraged the tendency to minimize the influence of heredity and to exaggerate the influence of learning.¹

¹For such a view, see J. B. Watson, *Behavior* (The People's Institute Publishing Co., New York, 1925). Another point of view will be found in E. L. Thorndike, *Educational Psychology*, Vol. I (1914), Teachers College, Columbia University, New York.

The two types of evidence are not entirely conclusive. First, it is difficult to separate the effects of "conditioning," or training, from the gradual cropping out of a form of behavior as the nervous mechanisms underlying that behavior mature. It is universally recognized that certain functions, the sex functions, for example, do not manifest themselves until twelve or fifteen years after birth and yet their character is known to be natively determined. Second, similar forms of behavior appear among widely scattered peoples where similarity in environmental influence can scarcely be presumed.

The problem is not a purely theoretical one; in fact, extremely important practical considerations are involved in education, business, industry and in other walks of life. If such undesirable traits as the fears, for example, are not native, but are acquired, then the remedy for them consists in the proper safeguards during early childhood. And if such desirable qualities as curiosity, intelligence, and the like, are not fixed in amount by nature, it is a question merely of adopting such educational measures as will give to each person the optimum amount of each. If, on the other hand, limits of attainment for the individual are set by his heredity, then early and later training can do no more than make the most of these native capacities, with the result that profound differences among individuals will continue to exist.

THE MECHANISM OF INHERITANCE

An effort will be made to avoid controversial matters as far as possible and to present the fundamental facts which are rather generally agreed upon. Underlying the whole question of inheritance is that of the mechanism of inheritance as well as that of the bodily seat of the inherited qualities. The problem of the mechanism of inheritance or the laws of inheritance is of great importance for the elimination

of bad and the preservation of good characters, but this problem is too involved to be discussed here. We are interested mainly in the study of the facts of inheritance; to put them together into a theory would be to select that biological theory into which the facts best fit.

So far as the bodily seat of the inherited qualities is concerned it may be said that they are represented by conditions in the central nervous system, the brain, or cerebrum, the cerebellum and the spinal cord. The nervous system is thought of as a system made up of centers and connecting pathways very much like a large telephone system with its central station, its local and private exchanges, and the tremendous number of wires connecting these stations. Certain pathways open to travel mean that certain bodily activities will take place when stimuli affect the senses. The inherited tendencies are conceived as conditions of lowered resistance in certain pathways which make them open to use without any previous exercise. Just as habits are thought of as certain changes produced in the conduction units, or neurones, so the inherited tendencies are represented by relatively simple and fixed paths of conduction predetermined for the individual, and certain more complex systems of conduction paths which are linked together so as to function in a predetermined way.

REFLEXES

The bodily mechanism is so constructed that at birth, and even before, certain simple forms of behavior will occur when particular stimuli affect the sense organs. A bright light falling into a newborn baby's eye will cause the pupil of the eye to contract; food placed in the mouth will cause acts of swallowing. These together with the acts of emptying the bowels and bladder and many more activities necessary for the preservation of life are known as reflexes. Some of them are automatic in character and completely independ-

ent of consciousness, as in the case of the pupillary reflex. They are present in all normal persons, and are so fixed in character that they do not vary except when the neural mechanisms on which they depend break down.² Other reflexes, such as the salivary reflex and those associated with it in the process of alimentation, are subject to a degree of modification, although always relatively independent of conscious control. On account of their relative fixity and because they do not represent responses of the organism as a whole, but only parts of it, they are of no great interest to the applied psychologist so long as they function normally. When, however, any abnormality develops in these reflexes, it may serve as a symptom of more severe behavior disturbances that will follow

INSTINCTS

In addition to the reflexes, there are more complex forms of behavior that represent responses of the organism as a whole to some situation which it encounters. For example, the fear response of an infant to a sudden loud noise consists in "a sudden catching of the breath, clutching randomly with the hands, the sudden closing of the eyes, and the puckering of the lips followed in some cases by crying."³ The name instinct is usually given to such a natural chain of reactions. One of the main distinctions between the instincts and the reflexes is that the former are readily modified in the course of the life experience. They are especially important to the student of behavior for three reasons:

1. The acquisition of all kinds of behavior, however

²For certain unusual modifications of the pupillary reaction by means of the "conditioned reflex" technique, see H. Cason, "The Conditioned Pupillary Reaction," *Journal of Experimental Psychology*, Vol. V (1922), pp. 108 ff.

³J. B. Watson and R. R. Watson, "Studies in Infant Psychology," *The Scientific Monthly*, December, 1921, p. 507.

complex and however much learning may be involved, constitutes modification of these original forms of behavior. It is a rule that all learning must proceed from the known to the unknown or that it consists in the modification of something that the individual can already do. Thus, if an organism lack some of the instinctive forms of behavior, its ultimate development will be defective to that extent.

2. Many of our acts throughout our whole life are the expression of these instinctive tendencies. However much they may be modified by experience and learning, we still retain the direct and unlearned form of response under many circumstances. This is especially true where for any reason the inhibitions placed by society upon our actions are removed or disregarded, as in great emotional disturbances, in anger, sorrow, joy and the like. Many of the atrocities committed by soldiers in war, and by persons in mobs, are attributed to the fact that these unlearned tendencies to action are no longer under control. But we act instinctively in many cases where one would not at first suspect it—the things we attend to, are interested in, and the things we like and dislike are to a large extent determined by instinct. A knowledge of the nature and the strength of these instinctive tendencies enables one to select stimuli for their arousal and consequently to exercise some control over the behavior of people.

Two examples from the business world will illustrate the use of a knowledge of the instincts. The advertising man who puts up the largest and most brilliant sign knows that, other things being equal, it will draw attention from its less brilliant neighbors, because we have an inborn tendency to be attracted by large and bright objects. Again, a book agent who tries to sell a dictionary to a mother and emphasizes its necessity for the education of her children will sell where another who neglects this point might not, because of the great strength of the parental instinct.

3. Instincts are subject to the most extreme variation in two directions with the result that certain tendencies may be abnormally strong or abnormally weak. In either case profound modifications of the total behavior result. Failure to recognize the deep-seated cause of many of the variations of human behavior, especially the criminal types of behavior, has led to a wrong conception of how such conditions may be successfully treated. An abundance of cases of abnormal tendencies may be found in the literature of the psychoneuroses⁴ in the form of phobias, depressions, and delusions, and in the form of pathological lying, stealing, and perversions of the sex reactions.

FIVE FUNDAMENTAL CHARACTERISTICS OF HUMAN NATURE

A complete catalogue of the instinctive tendencies of human beings is impossible at present on account of the unsettled state of our knowledge. Hence only those will be mentioned that are most important and most definitely established. The following are five of the fundamental characteristics of human nature:

1. We are born with the possibility of getting sensations of certain definite kinds when certain stimuli affect our sense organs. This simply means that we are born with sense organs and brain structure such that certain stimuli produce specific forms of reaction in consciousness. This fact is so obvious that it is likely to be overlooked, and yet the great change in the mental life caused by the failure of any part of this mechanism to function, as in the case of congenital blindness, shows the importance of this original equipment. Furthermore, we are given a mechanism of a *certain sensitivity* and this sensitivity cannot be increased directly. All that can be done is to make the best use of the mechanism as it is given to us. Individual differences

⁴ See Chap. XXVII.

in sensitivity are relatively fixed, and in each case mark the limits of efficiency beyond which the individual cannot go, however great his training.

2. Another characteristic of original nature provides that out of all the stimuli which affect the sense organs certain ones will come clearly into consciousness, while others will be crowded out. This means that there is a tendency to pay attention to certain kinds of stimuli and that others tend to be neglected.

Such natural attention is of the greatest importance, for it forms the foundation of all the highest forms of attention. If it be lacking there is no means by which the behavior of the individual may be modified. Moreover, we are born with the possibility of a certain strength of attention, and it is the difference in this native attention strength which is responsible for much of the difference in accomplishment of different individuals. For instance, according to some authorities that which makes the musician or the artist or the mathematician is, among other causes, the difference in the character and intensity of his original attentiveness rather than the fact that he has inherited some specific ability directly.

3. Of the stimuli that cause sensations and attract attention, some produce a pleasant effect and some produce an unpleasant effect. There is a feeling of the one kind or the other accompanying most, if not all, sensations. Thus a bitter taste is naturally unpleasant, as any one can discover who will try to feed something bitter to a very young baby. The way in which, during the course of evolution, certain stimuli have come to produce these unpleasant conscious states is interesting to speculate upon but does not alter the facts. More interesting than the feelings is the behavior that accompanies or follows them. In the presence of unpleasant stimuli, one naturally responds so as to get rid of the unpleasantness, and the responses continue in varying form until this result is accomplished. This variety of re-

sponse which follows upon the receipt of unpleasant experiences in the effort to get rid of them, and upon pleasant ones in the effort to retain them, is an important factor in the modification of the instinctive tendencies, which constitutes learning. Furthermore, as will be shown later, the strength of one's memory for objects or experiences depends among other things on the type of feelings they arouse, hence the importance of arousing the proper feeling tone in connection with experiences to be attended to or remembered.

4. Human beings have a natural tendency to be active both physically and mentally. The specific character of that activity may be, and usually is, determined by various factors in the environment, but the activity itself is the expression of a natural tendency. There is no such thing as laziness, strictly speaking. To refuse to be active is a symptom of defect or disease, lowered bodily tone, improper nourishment or the like. Laziness, however, is not so much inactivity as activity in a wrong or useless direction, as judged by social or ethical standards.

5. Of all the stimuli that affect the sense organs, are attended to, and cause a pleasant or unpleasant reaction, some leave a permanent effect, are remembered, and others are forgotten. This fact, like sensitiveness, is taken so much for granted that its great importance escapes attention until some abnormality appears. Retentiveness depends upon a fundamental characteristic of the nervous system, its impressibility, which is not subject to improvement. Thus one's possibilities of memory are fixed by his heredity, although his actual accomplishments within this limit may depend upon education and other factors.

OTHER NATIVE TENDENCIES

In addition to these five fundamental facts of inheritance, there are a number of more specific reactions to specific situations in our environment. When these are grouped and

classified according to their use or the purpose they serve, they are usually called Instincts. The statements made at the beginning of the chapter in regard to the instinct controversy should lead the reader to expect uncertainty concerning some of these specific reactions that are thus classed as instinctive. Certain ones that have been treated as native may, upon closer observation, be found to be learned in the early days of infancy. For a full discussion of these tendencies, the reader is referred to special texts on the subject. However, a few of them will be briefly described.

1. The instinct of self-preservation is a name given to a group of tendencies to action which protect the individual. In this group are included the food-taking tendencies, and all sorts of protective movements, such as putting out the hand when falling. The flight reaction accompanied by the mental state of fear is the tendency to protect oneself from dangerous objects. When the flight reaction is inhibited from any cause, the mental state may still be present and in very intense form. Whenever stimuli which naturally provoke a fear response are presented to an individual, one may be sure of a strong reaction on the part of the recipient. To take an example from the business world, any advertisement which works upon the fear of disease or death will be successful in producing some kind of a reaction, e.g., the recommendation of overshoes to prevent grippe, or the immediate use of dioxogen to prevent blood-poisoning and death.

2. *Curiosity*.—The appeal to one's curiosity is a powerful stimulus to action observed in both man and the animals. Sometimes, indeed, it is so powerful as to compete with the instinct of self-preservation. In cases like this an animal will risk its life in order to satisfy its curiosity. Animals are often caught by appealing to this tendency to examine or investigate. The makers of grab bags and prize packages well know the power of this "urge" to find out in children,

and many manufacturers seem to assume that it is just as strong in the case of adults. Modified and controlled by experience, this same curiosity forms the driving force of the scientific investigator. The point of importance for us is that it is a factor that must be taken into account in explaining the behavior of human beings, whether children or adults; and, further, that persons differ in the strength of this tendency to investigate and examine.

3. *Collecting Instinct*.—The collecting instinct in animals is well illustrated in the case of the wood-rat cited by James.⁵

I found the outside of the nest to be composed entirely of spikes, all laid with symmetry, so as to present the points of the nails outward. In the center of this mass was the nest, composed of finely divided fibers of hemp-packing. Interlaced with the spikes were the following: about two dozen knives, forks and spoons; all the butcher's knives, three in number; a large carving knife, fork and steel; several large plugs of tobacco . . . an old purse containing some silver, matches and tobacco; nearly all the small tools from the tool closets, with several large augers . . . all of which must have been transported some distance, as they were originally stored in different parts of the house. The outside casing of a silver watch was disposed of in one part of the pile, the glass of the same watch in another, and the works in still another.

The boy's pocket which contains such a variety of objects also bears witness of the force of this collecting tendency. Nearly every one has at some time or other had a hobby for collecting some quite useless article, coins, buttons, stamps, tobacco tags and the like. To the force of this instinctive tendency, more than to the actual value of these objects, is due the great popularity of trading stamps, souvenirs, coupons, etc. The abnormal development of this

⁵W. James, *Principles of Psychology*, Vol. II (Henry Holt and Co., New York, 1890), p. 424.

tendency is made responsible for the hoarding of gold by the miser, the thefts of the kleptomaniac, and the collecting of absurd articles by inmates of institutions for the insane.

4. *Pugnacity*.—The fighting instinct in human beings, on account of the power of social order, does not commonly show itself in physical combat. But the love of combat may take the milder form of watching a cock fight, dog fight, or a pugilistic contest. Most frequently it shows itself as emulation and rivalry of a more kindly sort, and is a healthy stimulus to do one's best and better than one's neighbor. The self-assertion motive, which is given great prominence in certain interpretations of behavior, as well as the anger reaction, probably falls within this group. The slavery of fashion is due in part to this instinct; and the limits to which people will go to outdo each other in following the latest styles shows the intensity of the motive. When the rivalry consists in trying to excel one's own past record, it becomes one of the most valuable tools of education and industry.

5. *Sociability*.—There is a very definite tendency among animals and human beings to gather into groups and to react unpleasantly toward solitude. One of the most terrible punishments to which a human being can be subjected is solitary confinement. Many animals become terror stricken when separated from their fellows and give evidence of joy when returned to them. The great popularity of seaside resorts, circuses, football and baseball games, is due in large part to the crowds and the consequent stimulus to this instinctive tendency. Who would enjoy a great football game if he had to stand alone in the cold and watch it? The theater managers, too, know well the influence of a full house upon the popularity of a play. According to McDougall,^a those of us who explain our enjoyment of crowds

^aW. McDougall, *An Introduction to Social Psychology* (J. W. Luce and Co., Boston, 1909).

as a purely intellectual interest in people are really misinterpreting an attempt to satisfy our sociability instinct.

An abnormal development of this instinct is counted among the fears. The fear of being alone, the fear of being in open places, such as street crossings, may be considered as a variation of this instinct. The latter is generally relieved or absent in the presence of other people.

6. *Imitation*.—Although a tendency to imitate, which would enable one to repeat what he sees being done by another and what he had before been unable to do, is denied by many present-day psychologists as a powerful factor in learning new acts, still the term "imitation" is of use in describing certain tendencies in human conduct. The quarrel is as to whether one's learning is in the last analysis reducible to imitation. This question will be dealt with in connection with the problem of learning. The so-called psychology of the crowd which attempts to account for what a crowd will do that one isolated individual will not do, is the psychology of imitation. This, of course, is not a matter of learning to do something new, but merely a determination of which act of a great number of learned ones shall be carried on at a given time. The strength of this tendency is well recognized by the business world, which makes it the basis of many of its appeals to purchasers, and by industry, which uses it as a stimulus to increased activity. To take the last-named case, it is a common thing in industries where efficiency is the aim, to put a good man in the midst of a group of slower individuals on the assumption that the poorer ones will imitate the better and thus be urged to increased activity.

7. There is a group of instinctive tendencies called racial, on account of their value to the race or species rather than to the individual. These are very powerful and deep-seated tendencies to action and must be considered in a study of behavior. They are generally characterized by unconsciousness

of the end to which they lead. In animals they are the most common and powerful instincts, comprising the nest-building and the egg-laying instincts, the care of the young, the protection of the group at the cost of the individual life, and the procreation of offspring. In man they are much more difficult to identify, because, by the time they manifest themselves, the native forms of response are overlaid with a great complex of habits, and also because their manifestation is curbed, veiled and modified by social laws and customs. But in the form of the parental instincts and the sex instincts with the acts of courtship, love and jealousy, and the bearing and rearing of children, they form a powerful group of motives in the determination of behavior.

In the field of pathological psychology, the sex motives have been raised to a very exalted position as determinants of abnormal behavior, with a distinct trend toward the interpretation of all normal behavior in the same fashion. Barring such undue emphasis upon them, their importance in the motivation of behavior may be granted.⁷

NATIVE RACIAL DIFFERENCES

The significance for applied psychology of the material just presented rests not only upon the fact that it shows the core out of which human nature is unfolded and expanded through contact with environmental and cultural forces, but also because quantitative differences in the native endowment of individuals in these respects set the limit of possible development for each and create the great problem of human adjustment. In addition to the problems of individual differences and the adjustments they require, there arises the question whether there are characteristics of mind and behavior peculiar to the different racial groups, which need to be considered from the point of view of

⁷ See Chap. XXVII for a discussion of psychoanalysis.

efficiency. We hear much nowadays about hereditary racial differences—that the Germans represent a race with certain characteristics, the French with others, the English with others—with practically no attempt to separate the facts of inheritance from the effects of education, customs and general environmental conditions. Furthermore, there is little or no regard for the great admixture of racial stocks, with the result that nationality differences do not correspond in most instances to racial differences.

RACE DIFFERENCES IN INTELLECT

The first experimental studies were made upon rather simple functions such as sensory acuity, motor ability (speed of reaction, speed of tapping, etc.), and simple judgments (form board test, etc.). Although these traits are simple, yet they are characteristics in which peoples are supposed in the popular mind to differ. For instance, certain races are thought to have remarkably keen vision, others are said to be very slow, others very quick in their reactions. The upshot of all experimental tests seems to be that the racial differences in fundamental qualities independent of training are slight. There is in every case, even in sensory acuity and speed of reaction, much variability among the members of the same race, so that in the race making the best records there are always some individuals who do as poorly as some of the best individuals in the poorer races. Woodworth,⁸ in discussing the results of the form board test, which is a fair test of intelligence and little dependent on specific training, and which he tried on a number of different races, says:

As between whites, Indians, Eskimos, Ainus, Filipinos and Singalese, the average differences were small and much over-

⁸ R. S. Woodworth, "Racial Differences in Mental Traits," *Science*, Vol. XXXI (1910), p. 171.

lapping occurred. As between these groups, however, and the Igorot and Negrito from the Philippines and a few reputed Pigmies from the Congo, the average differences were great and the overlapping was small. . . . If the results could be taken at their face value they would indicate differences of intelligence between races, giving such races as the Pigmy and the Negrito a low station as compared with that of most mankind. The fairness of the test is, however, not beyond question; it may have been of a more unfamiliar sort to these wild hunting folk than to the more settled groups. This crumb is, at any rate, about all the testing psychologist has yet to offer on the question of racial differences in intelligence.

When one takes the full meaning of this statement, namely, that between the highest and the lowest races there are no differences which have up to this time been positively established, it is scarcely to be expected that differences of any importance would be found among the higher races.

MENTAL STATUS OF NEGROES AND WHITES

More comparative measurements have been made of the Negroes and whites than of any other pair of races. Galton believed that, making allowance for difference of environment, the Negroes were inferior to Europeans by about one-eighth of the difference between Aristotle and the lowest idiot. The measurements made by Mayo⁹ of Negroes and whites of approximately the same social standing in the New York City public schools are worth mentioning in this connection. Although the two groups were perhaps not exactly comparable on account of the different social status of the two races, the difference is not very considerable. It has been estimated that the Negroes represented a somewhat more rigid selection than the whites. Mayo studied the academic records of the two groups, and concluded that in academic achievement only three-tenths of the Negroes

⁹ M. J. Mayo, "The Mental Capacity of the Negro," *Archives of Psychology* No. 33 (1915)

reached a position attained by one-half of the whites. This means that the range from zero up to a grade of 70 would include 50% of the whites and 70% of the blacks. Further, he found the variability of the Negroes to be slightly less than that of the whites. This would be the more important finding, if the difference in variability were large enough to be significant. It would mean that among the whites there would be a greater chance for exceptional individuals to appear, both good and bad; that is, one would expect the men who became greatest to be white rather than black. The distribution of school marks for the two racial groups is presented in Table II, together with measures of central tendency and variation, showing a difference of four points between the median scores of the two groups.

TABLE II. RELATION BETWEEN WHITES AND NEGROES IN SCHOOL ACHIEVEMENT

MEDIAN MARKS, ALL SUBJECTS	NUMBER OF CASES	
	Whites	Negroes
0 to 29	0	1
30 to 39	2	0
40 to 49	3	8
50 to 59	17	39
60 to 69	75	83
70 to 79	36	10
80 to 89	9	5
90 to 100	3	1
Median Score	66	62
Average Deviation	7.0	6.5
Difference 4 points		

The New York City population of Negroes does not represent a random selection from the Negro population of the United States, and, as has already been suggested, the high-school population is not a random selection of the Negroes from the city. In order to avoid such selection and to

escape from the errors which are inherent in school marks, Ferguson¹⁰ applied a series of mental tests to the Negro high-school students of three southern cities and to "equivalent groups" of white students. If all test records are combined for boys and girls, it is found that 33 per cent of the Negroes reach or exceed the average of the whites. If one test, measuring speed of perception, is omitted, the percentage falls to 27. Ferguson concludes: "The average performance of the colored population of this country in such intellectual work as that represented by the tests of higher capacity, appears to be only about three-fourths as efficient as the performance of whites of the same amount of training. It is probable, indeed, that this estimate is too high rather than too low." When he classified the colored students according to the admixture of white, estimated from skin color, he found that, the greater the proportion of white, the more nearly did the score of the Negroes approximate that of the whites. It would appear probable that the correct evaluation of the race differences would lie somewhere between the findings of Mayo and Ferguson, for, although the Negroes of New York City were highly selected, the educational facilities available for the Negroes of the southern cities were not up to the standard of those of the white population. These two studies show the difficulties that are met in making any comparison of the mental status of racial groups.

INTELLIGENCE DIFFERENCES OF NATIONALITY GROUPS IN THE UNITED STATES

The largest body of data concerning the relation between intelligence and nationality has been supplied from the records of the psychological examinations in the United States Army. An intelligence examination, in one or other of its

¹⁰ G. O. Ferguson, "The Psychology of the Negro," *Archives of Psychology* No. 36 (1916).

forms, was administered to natives of sixteen foreign countries in numbers sufficiently large to make conclusions from them fairly reliable. Figure 1¹¹ shows the distribution of scores among the representatives of these nations. The records are in terms of the letter grades A, B, C and D, in which A stands for the highest grade of intelligence and D for the lowest, and which are designated by the types of shading indicated at the bottom of the chart.

The range of differences among the countries is a very wide one. While 8.7% of the men from England made a grade of D or less, almost 70% of the Poles were found in these low grades. The Scandinavian and English-speaking countries show relatively high scores, while the Slavic and Latin countries show low scores. The intelligence ratings of these foreign groups cannot be taken as an indication of the level of intelligence of the countries from which they came. There are, among other factors to be considered, differing forces at work in the various countries tending to control the character of emigration. There is also the possibility that the Army intelligence tests (Alpha or Beta) do not give equal opportunity to all racial groups to show their native capacity.¹² But it is significant that within the population of the United States the foreign groups differ so much, whatever the cause of these differences may be. The results of the tests show, at least, the varying difficulty that representatives of different countries meet in adapting themselves to the environment offered by the United States. A further analysis of the scores for foreign-born groups suggests that adaptation to the test conditions does take place. When the foreign born are grouped according to years of

¹¹ *Psychological Examining in the United States Army. Memoirs of the National Academy of Sciences*, Vol. XV, p. 697.

¹² A *Universal Scale of Individual Performance Tests*, described as suitable for the measurements of nationality differences, has been published by P. C. Squires (Princeton University Press, 1926).

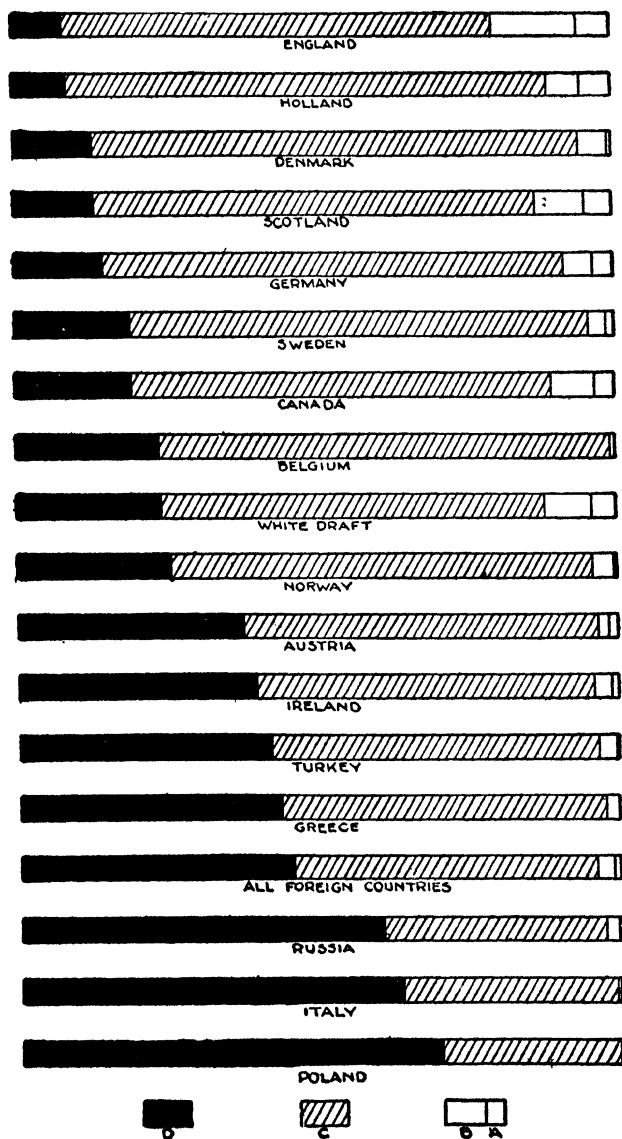


FIG. 1. DISTRIBUTION OF INTELLIGENCE TEST SCORES AMONG NATIONALITY GROUPS

residence in the United States, a regular increase in the scores occurs with each added five years of residence. This increase, in terms of mental age, amounts to more than two years for residence periods ranging from five years or less to twenty years or more. It is well to recognize that some doubt exists as to the correct interpretation of this change of intelligence score with length of residence, as indicated in the following quotation:¹³

Apparently then the group that has been longer resident in this country does somewhat better in intelligence examination. It is not possible to state whether the difference is caused by the better adaptation of the more thoroughly Americanized group to the situation of the examination or whether some other factor is operative. It might be, for instance, that the more intelligent immigrants succeed and therefore remain in this country, but this suggestion is weakened by the fact that so many successful immigrants do return to Europe. At best we can but leave for future decision the question as to whether the differences represent a real difference of intelligence or an artifact of the method of examination.

The bearing of these findings upon the question of the control of immigration is already receiving considerable attention. Equally important psychological problems arise in connection with the adjustment of our educational and industrial systems to meet the demands imposed upon them by these varying foreign groups.¹⁴

NATIONALITY DIFFERENCES IN TEMPERAMENT AND EMOTION

The casual observation of nationality differences would lead to the expectation of greater differences in tempera-

¹³ *Psychological Examining in the United States Army. Memoirs of the National Academy of Sciences*, Vol. XV, p. 704.

¹⁴ An analysis of these data and their implications will be found in C. C. Brigham, *A Study of American Intelligence* (Princeton University Press, 1923).

ment, emotional attitudes and general excitability than in intelligence. Such popular notions are, however, difficult to verify at present because suitable tests for the purpose are not available. National differences in excitability might be measured by means of the psychogalvanometer technique, but such an investigation has not been reported. An attempt has been made to measure temperamental differences by means of the Will-Temperament Test of Downey. In such a project there are added to the problems of selection those arising from the use of a measuring instrument whose value has not been definitely established. The differences that have been found are small and not well established. The nature of the findings is illustrated in the following paragraph:¹⁵

"In predominance of temperamental patterns, the whites slightly surpass the Negroes in the number of mobile, rapid-fire individuals; they have a clear superiority in the number of controlled, deliberate, careful persons; and they slightly surpass the Negroes in the number of individuals showing a combination of these two characteristics. The Negroes slightly surpass the whites in the number of aggressive persons and in the number of individuals combining quickness and mobility with aggressiveness, and also in the number of individuals combining aggressiveness and deliberation."

The experiment of Crane¹⁶ represents a unique attempt to discover non-intelligence differences between whites and Negroes. Taking as a starting point certain commonly observed differences in impulsiveness, improvidence, etc., he argued that the differences might be due to greater strength

¹⁵ J. H. McFadden and J. F. Dashiell, "Racial Differences as Measured by the Downey Will-Temperament Test," *Journal of Applied Psychology*, Vol. VII (1923), pp. 30 ff.

¹⁶ A. L. Crane, "Race Differences in Inhibition," *Archives of Psychology* No. 63 (1923).

of impulses in the Negro, inferior mentality preventing foresight as a basis for control of behavior, or a lack of inhibitory power in the regulation of behavior. He then conducted tests upon 100 whites and 100 Negroes which were calculated to measure these three characteristics. Grade of mentality was measured by means of an individual intelligence examination. The strength of impulses (fear was chosen as a sample) was measured by the withdrawal of the hand from a falling weight, and inhibitory power was measured by the inhibition of the withdrawing movement, accompanied by twitching or "flinching" of the muscles involved in the withdrawal movement and by disturbances of the breathing. He found among the white subjects fewer withdrawals of the hand, but a greater *tendency* to withdraw it as indicated by muscle twitch and breathing. He concluded that the behavior differences between the two races were due not so much to intelligence or strength of impulses as to differences in the power of inhibition.

The survey of the literature upon race differences, only a sampling of which is given in this chapter, leads to the conclusion that, in the simpler functions at least, the likenesses are more striking than the differences. Greater differences will undoubtedly be found when "higher" intellectual traits and temperamental characteristics can be satisfactorily measured. From the point of view of applied psychology, the probability is that it will always be more effective to select for any given purpose the superior individual regardless of race than to choose one because he is a member of a given race. The differences among persons of a given race are likely to be many times greater than the average difference between races as a whole.

CHAPTER III

THE INFLUENCE OF FAMILY INHERITANCE UPON ACHIEVEMENT

IN addition to the original nature common to the human species as a whole and to the specific race to which one belongs, every individual possesses certain traits by virtue of having a certain immediate ancestry—parents, grandparents, great-grandparents, etc.¹ The influence of ancestry upon a number of physical characteristics such as eye and hair color, height, etc., has been worked out. Mental resemblances are not so definitely determined, but those which have been found, supported by the certainty of physical inheritance, lead us to expect that one's immediate ancestry is of considerable importance in determining what his mental qualities shall be.

THE INHERITANCE OF PHYSICAL TRAITS

It should not be expected that, if heredity is a real factor, two persons of the same ancestry should have original natures which are identical in every respect, except as a different environment changed them. This may be easily proved by taking physical characters which cannot be affected by environment, such as the color of the eyes. The relationship between brothers in eye color may be expressed in a numerical form, known as the coefficient of correlation. When degree of resemblance or relationship is thus ex-

¹ For a simple presentation of the mechanism of inheritance, see E. G. Conklin, *Heredity and Environment in the Development of Man* (Princeton University Press, 1923).

pressed, a purely chance relationship will give a coefficient of zero, a perfect relationship will give a coefficient of $+1.00$, and a completely reversed relationship will give a coefficient of -1.00 . There may, then, be various degrees of relationship from $+1.00$ through 0 to -1.00 . Thus, if every person who had a brother with blue eyes had blue eyes also, and if every person who had a brother with gray eyes had gray eyes also, and so on with every color, then the coefficient would be $+1.00$. But if one with blue eyes were equally likely to have a brother with any eye color, then the coefficient would be zero. The relationship actually found between brothers in eye color is represented by a coefficient of correlation of $+ .52$.²

Height may be taken as another illustration. Children of parents who are three inches above the average in height, will average only about two inches above the average, i. e., they will not be identical in height with their parents but will tend toward the average of the whole race. Thorndike³ describes the reason for these variations as follows:

In all thought of inheritance, physical or mental, one should always remember that children spring, not from their parents' bodies and minds, but from the germs of those parents. The qualities of the germs of a man are what we should know in order to prophesy directly the traits of his children. One quality these germs surely possess. They are variable. Discarding syntax and elegance for emphasis, we may say that the germs of a six-foot man include some six-foot germs, some six-foot-one germs, some six-foot-two, some five-foot-eleven, some five-foot-ten, etc. Each human being gives to the future, not himself, but a variable group of germs. This hypothesis of the variability of

² A very clear presentation of the detailed procedure involved in such calculations will be found in H. E. Garrett, *Statistics in Psychology and Education* (Longmans, Green and Company, New York, 1926).

³ E. L. Thorndike, *Educational Psychology*, Vol. III, p. 227 (Teachers College, Columbia University, 1913).

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the germs explains the fact that short parents may have tall sons, gifted parents stupid sons, the same parents unlike sons.

Other well-established relations between relatives in regard to physical traits are:

<i>Trait</i>	<i>Individuals</i>	<i>Correlation</i>
Height	father and son	+ .30
"	brother and brother	+ .50
Cephalic index	brother and brother	+ .50
Hair color	brother and brother	+ .60

These figures show very clearly that one owes his physical characteristics to a certain extent to his immediate ancestry.

Consider next a characteristic that comes a little nearer to being mental, namely, deafness. It has been found from statistical studies that out of every four persons who have one brother or sister congenitally deaf, *one* is deaf, while of those persons who have neither brothers nor sisters born deaf, only one out of a thousand is deaf. This means that if one is of the same immediate ancestry as a person congenitally deaf, he is about two hundred and fifty times more likely to be deaf than a person who is of the same ancestry as a person with normal hearing.

THE INHERITANCE OF INTELLIGENCE

The question of the inheritance of intellect, always of vital interest, has attracted an ever increasing amount of attention with the development of standardized measures of intelligence, and with the growing acceptance of the intelligence quotient as a fixed quantity. The earlier studies of inheritance of mental traits, beginning with that of Galton,⁴ were based upon the achievements of related individuals and upon estimates of their ability. These studies tended to magnify the importance of heredity, as there was

⁴ F. Galton, *Hereditary Genius* (Macmillan Co., New York, 1869).

no valid means of discounting the effects of environmental influences. Galton found, among his 977 eminent men, over 300 times as many eminent relatives—fathers, brothers and sons—as would be expected from the same number of average men. This finding, he believed, could not be attributed to the quality of training derived from membership in the eminent families. Likewise, the study of the heredity of about 700 royal personages led Woods⁵ to attribute their attainments largely to heredity.

TABLE III. PARENTAGE OF EMINENT MEN

	Number	Per Cent	Number	Per Cent
Professional Classes			381	43.0
Clergymen	89	10.1		
Physicians	66	7.5		
Lawyers	58	6.6		
Teachers	74	8.3		
Others	94	10.6		
Agriculture			188	21.2
Manufacture and Trade			316	35.7

The more recent statistical study of eminent men and their families by Cattell⁶ is especially interesting. He found the occupations of the fathers of 885 noted men of science to be as shown in Table III. The census of 1850, which represents about the period when the generation he studied was born, showed that, of the white population of the United States, the professions comprised only 3.1 per cent, agriculture 44.1 per cent and manufacture and trade 34.1 per cent. Thus it appears that the professions, which comprise 3.1 per cent of the population, produced 43 per cent of the scientific

⁵F. A. Woods, *Mental and Moral Heredity in Royalty* (Henry Holt and Co., New York, 1906).

⁶J. McK. Cattell, "Families of American Men of Science," *Popular Science Monthly*, May, 1915, and *Scientific Monthly*, October, 1917.

men of the country, while manufacture, trade and agriculture, comprising 78.2 per cent of the population, produced the remaining 57 per cent.

Working over the same data, Brimhall⁷ found the frequency of eminence among near and remote relatives of 1,000 eminent men. His results show that a distinguished man of science is about 75 times as likely to have a distinguished brother as is a man from the generality, and about 70 times as likely to have a distinguished sister as is a man from the generality. He found, further, that the likelihood of distinction decreases with the remoteness of relationship to the distinguished individual.

The conclusion of Cattell will apply to both these studies. He sees in the figures the combined influence of inheritance and opportunity represented by family influence and tradition, geographical location, etc. Concerning the relative potency of heredity and environment he says:

We may conclude that more than one half of our men of science come from the one per cent of the population most favorably situated to produce them. The son of a successful professional man is fifty times as likely to become a leading scientific man as a boy taken at random from the community. . . . A boy is fifty times as likely to do scientific work as a girl. No Negro in this country has, hitherto, accomplished scientific work entitling him to be included among our leading thousand scientific men. A boy from the professional classes in New England has a million chances to become a scientific leader as compared with one chance for a Negro girl from the cotton fields.

These great differences may properly be attributed in part to natural capacity and in part to opportunity. When it is asked how far the result is due to each of these factors, the question is in a sense ambiguous. It is like asking whether the extension of a spiral spring is due to the spring or to the force applied.

⁷ D. R. Brimhall, "Family Resemblances among American Men of Science," *The American Naturalist*, November, 1922, to August, 1923.

Some springs cannot be extended a foot by any force; no spring can be extended without force.

One of the pioneer studies of mental heredity by means of psychological tests was made by Thorndike⁸ in his *Measurement of Twins*. He used a variety of simple mental tests upon fifty pairs of twins and found an average correlation between them of $+.80$, as compared with a correlation of $+.40$ for brothers and sisters, with the correlation among unrelated children taken as zero. Taking into account the degrees of resemblance of twins of different ages, the degrees of resemblance in traits varying in susceptibility to training, and the comparison of twins with siblings (ordinary brothers and sisters) in these respects, left no doubt that heredity is the potent factor in determining the similarity of performance. The more recent studies of twin resemblance, by means of the best standardized measuring instruments, confirm in essential respects the findings of Thorndike. For instance, Merriman⁹ found between all twin pairs a correlation of $+.78$, when measured with the Stanford-Binet examination. When the twins were classified into like-sex pairs and unlike-sex pairs, the correlation for the former was $+.87$ and for the latter was $+.50$. That is, the unlike pairs approach siblings in their degree of resemblance, while the like-sex pairs approach a perfect correlation. Genetically speaking, it is believed that unlike-sex twins do not differ from ordinary brothers and sisters, and this is confirmed by the results of the tests.

Terman,¹⁰ in a study of the mental and physical traits of a thousand gifted children, classified the parents according to

⁸E. L. Thorndike, *Measurement of Twins* (Science Press, New York, 1905).

⁹C. Merriman, "Intellectual Resemblance of Twins," *Psychological Monographs*, Vol. XXXIII, No. 152 (1924).

¹⁰L. M. Terman, *Genetic Studies of Genius* (Stanford University Press, 1925).

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TABLE IV. PARENTAGE OF GIFTED CHILDREN

	<i>Per Cent of Fathers</i>
Professional	31.4
Semi-Professional and Business	50.0
Higher Group	31.2
Lower Group	18.8
Skilled Labor	11.8
Semi-Skilled to Slightly Skilled	6.6
Common Labor	0.13

their occupation. The results which are shown in Table IV furnish valuable support for the data of Cattell given on page 44. Whereas Cattell measured adults in terms of their achievements from which the influence of environment could not readily be disentangled, Terman measured the intelligence test performance of children too young to be affected by such differences in environment as might later be operative. An examination of a number of environmental factors such as financial status of parents, home conditions and residence neighborhood, revealed no differences sufficient to account for the intelligence differences. Terman believes, therefore, that these children are gifted by original nature, and are not merely the product of a favorable environment.

Terman adopted another way of showing the intellectual status of the parents of the gifted children, namely, transmuting occupational status into intelligence status by means of the Barr scale of occupational intelligence. These figures may then be compared with the same kind of rating of adults of the generality, when allowance has been made for the frequency of the different occupational groups. Table V gives these data. The first column gives the Barr rating, the second gives the per cent of the fathers of the gifted children attaining a certain rating, and the third column gives the per cent of adults of the generality reaching a certain rating. It would appear from this comparison that

TABLE V. PARENTS OF GIFTED CHILDREN VERSUS THE GENERALITY

BARR RATING	Per Cent of Fathers of Gifted	Per Cent of Adults of Generality
15 or above	26.8	2.2
12 to 15	26.8	4.5
9 to 12	36.1	37.0
6 to 9	8.9	13.4
3 to 6	1.3	42.9

the parents of the gifted children are as highly selected for intelligence as are the children themselves.

THE INHERITANCE OF MENTAL DEFECT

The belief in the inheritance of mental characteristics has received considerable support from the recent studies of mental defectives. It is always easier to trace the transmission of defects than normal traits, because of the more obtrusive character of the former. Especially clear is the inheritance of the defects resulting from incomplete or retarded structural development of the nervous system, giving such deviations from the normal as weak-mindedness, imbecility, idiocy, etc.

Goddard¹¹ has made a study of mental defect in two lines coming from related ancestral stocks. A man of good stock had an illegitimate child by a weak-minded girl and then later married a woman of good stock who bore children. The descendants of the same father by two different mothers have been traced for a number of generations. In the case of the descendants from the offspring of the weak-minded girl there is a continuous series of incompetents, drunkards, drug users, prostitutes, etc., while the

¹¹ H. H. Goddard, *The Kallikak Family* (The Macmillan Co., New York, 1912).

other branch of the family shows a long line of people of good standing.

What makes this case of particular value is the fact that both lines of descendants continued to live in the same neighborhood for generations. The history of the two families shows the transmissibility of mental defect, and more than this, it shows that what is transmitted is here a general mental deficiency which may show itself in a great variety of ways depending on the specific conditions affecting different persons.

The use of the intelligence test to determine the resemblance between mentally defective children and their parents is beset with many difficulties. The lack of coöperation is in strong contrast to that received in the investigation of gifted children and for a very obvious reason. In spite of the difficulties to be met, the problem deserves investigation. The work of Moorrees¹² is an attempt to measure, by means of individual mental tests, the resemblance between the feeble-minded children confined in a public institution and their parents. The median I.Q. of the children was 29.4, while that of the fathers was 73.0 and that of the mothers was 64.0. Of the 45 children studied, 33 have either one or both parents below the border line of intelligence. Two kinds of selection must be allowed for in the interpretation of this study. The parents were those who "through poverty, lack of feeling, or incompetence, cannot provide for their children without the help of the State." The children, moreover, undoubtedly represent the lowest grade or the most troublesome individual in each family. It seems safe to conclude from this investigation, supported by a mass of clinical data, that mental deficiency as well as mental superiority, may be transmitted from parent to child.

¹² V. Moorrees, "The Immediate Heredity of Primary Aments Committed to a Public Institution," *Journal of Applied Psychology*, Vol. VIII (1924), pp. 89 ff.

INHERITANCE OF SPECIFIC MENTAL ABILITIES

Francis Galton¹³ many years ago made a statistical study of the inheritance of *specific* mental abilities and found that the abilities required for success as a judge, statesman, minister, commander, poet, artist and scientific man, are inherited. But the nature of his data makes him unable to make exact allowance for influences of training and environmental influences. Consequently, his figures might really show general intelligence to be inherited and the form of its expression to be dependent upon environment.

Other investigators, among them F. A. Woods¹⁴ and Havelock Ellis,¹⁵ have made similar statistical studies and conclude that there is inheritance of even such qualities as temper, common sense and the like, but these reports are also subject to the same complicating influence of environment. Pearson¹⁶ measured the resemblance among members of the same family in such traits as vivacity, popularity, conscientiousness, temper and self-assertiveness, and found correlations of about $+.50$, assuming the resemblance of unrelated children to be zero. The evaluations of the children, 2,000 in number, consisted of ratings by their teachers in respect to the various traits. It is difficult to estimate the errors involved in such measurements, and the probable effect that the errors would have upon the size of the correlation obtained.

The influence of inheritance upon a *very specific* mental quality, namely, spelling ability, has been tested experimen-

¹³ F. Galton, *Hereditary Genius* (The Macmillan Co., New York, 1869).

¹⁴ F. A. Woods, *Mental and Moral Heredity in Royalty* (Henry Holt and Co., New York, 1906).

¹⁵ H. Ellis, *A Study of British Genius* (Hurst and Blackett, London, 1904).

¹⁶ K. Pearson, "On the Inheritance of Mental and Moral Characters in Man," *Biometrika*, Vol. III (1904), pp. 131 ff.

tally, although here there is some difficulty in separating the influence of heredity from that of environment. Earle¹⁷ studied the spelling ability of 180 pairs of brothers and sisters, who had uniform school training, and found a correlation between brother and sister of $+.50$. This means that, if one child deviated by a certain amount from the average child in spelling ability, his brother or sister would deviate from the average child just half as much, that is, he would resemble his brother or sister to that extent.

Thorndike's study of twins, previously referred to, furnishes evidence from actual mental measurement on the question of the inheritance of special abilities. The correlations in the various tests ranged from $+.69$ for the checking of letters (A Test) to $+.90$ for the naming of opposites (Opposites Test). He concludes that the available knowledge supports the view that the original nature of man is an organization of specific functions, so that individual traits and combinations of these show similarity in father and children, brothers and sisters.

THE INHERITANCE OF DISEASE

The inheritance of insanity is more difficult to demonstrate than that of feeble-mindedness, but numerous statistical studies tend to show that this, too, may be transmitted. In the analysis of 18 families in which both parents suffered from insanity, or nervous breakdown, or were suicides, 39 per cent of the offspring were found to be affected. In 90 families where only one parent was insane, only 9.6 per cent of the offspring were affected.

Granting now that certain physical characteristics and conditions of high and low intelligence and possibly some

¹⁷ E. L. Earle, "The Inheritance of the Ability to Learn to Spell," *Columbia Contributions to Philosophy, Psychology and Education*, 1903, pp. 41 ff.

more particular mental traits are inheritable, are specific tendencies of another kind inherited, such as particular diseases, the drink habit, drug habit and the like? The balance of opinion to-day is against this sort of inheritance, using the term in its strict sense. But it is granted that a child may be born afflicted with disease as a result of parental infection before birth, or may be born with a constitution so low in general vitality that stimuli will be sought of the drug or alcoholic sort, in order to enable it to compete in the struggle for existence. Or again it may be born with a low vitality, with the result that it is very susceptible to disease.

From the standpoint of any one individual life and its efficiency, the question of actual inheritance of disease may not seem to have so much importance, since when one finds himself afflicted with a disease or habit no distinction between real inheritance and prenatal influence can be made. But when one considers the chances of transmission to future generations, then the distinction between inherited and acquired conditions becomes quite important. For example, if a mother is afflicted with tuberculosis, and gives birth to a child, the child may become infected with the tubercle bacillus, by way of the blood of the mother, although such cases are thought to be extremely rare. Infection of the embryo with syphilis is, on the contrary, quite common. Both of these cases are examples of prenatal infection and not real inheritance. What most frequently happens is that the embryo is interfered with in its development so that the child is born with a weakened constitution, with its vitality below par, and on this account may be highly susceptible to the tubercle bacillus or any other disease germ. An individual born in this condition is far better off than one endowed by heredity with a specific disease or habit would be. By proper living and proper selection of occupation, the former may escape many of the ill-effects of his inheritance, while

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the latter, being born with the condition, must either be cured or be doomed.

THE CONTROL OF INHERITANCE

From the point of view of the production and development of efficient individuals, therefore, the question of family inheritance is of great importance. It demands that only individuals with the possibility of efficient lives be born. This means such control of marriages as now exists in many states, namely, the refusal of marriage licenses in the absence of a clean bill of health and evidence of normal mentality from the contracting parties. Every state and territory but the following eleven have enacted laws preventing marriage in case of one or more of the various kinds of deficiency, including imbecility, feeble-mindedness, epilepsy, idiocy and venereal diseases:

Alabama	Louisiana	Tennessee
Arizona	Missouri	Texas
Colorado	New Hampshire	Alaska
Florida	New Mexico	

The production of none but efficient individuals means further that individuals known to be defective shall be prevented from having offspring, a matter also regulated in some states by law. Asexualization, or the performance of operations to prevent the possibility of offspring, is provided for by law in the following states, in case of various kinds of defectiveness:

California	Nevada
Connecticut	New Jersey
Indiana	New York
Iowa	North Dakota
Kansas	Washington
Michigan	Wisconsin

In the following states bills have been proposed but lost:

Arizona
Illinois
Minnesota

Vermont
Virginia

In Oregon a bill was passed by the Legislature and killed by a referendum vote of the people. In the states where there are laws, they usually begin somewhat as follows: "Whereas heredity plays a most important part in the transmission of crime, idiocy and imbecility, . . ." The following is an extract from a law concerning the prevention of offspring in the state of Iowa, which may serve as an example of the others:

It shall be the duty of the state board of parole, with the managing officer and the physician of each public institution in the state, entrusted with the care and custody of criminals, rapists, idiots, feeble-minded, imbeciles, lunatics, drunkards, drug fiends, epileptics, syphilitics, moral and sexual perverts, and diseased and degenerate persons, and they are hereby authorized and directed to, annually or oftener, examine into the mental and physical condition, the records and family history of the inmates of such institutions, with a view of determining whether it is improper or inadvisable to allow any of such inmates to procreate and to judge of such matters. If a majority of them decide that a procreation by any of such inmates would produce children with a tendency to disease, deformity, crime, insanity, feeble-mindedness, idiocy, imbecility, epilepsy or alcoholism, or if the physical or mental condition of any such inmate will probably be materially improved thereby, or if such inmate is an epileptic or syphilitic, or gives evidence, while an inmate of such institution, that he or she is a moral or sexual pervert, then the physician of the institution, or one selected by him, shall perform the operation of vasectomy or ligation of the fallopian tubes, as the case may be, upon such person. Provided that such operation shall be performed upon every convict or inmate of such institution who has been convicted of prostitution or violation of the law as laid down in or who has been twice convicted of other sexual offenses, including soliciting, as defined in or who has been twice convicted of a felony, and each such convict

or inmate shall be subjected to this same operation of vasectomy or ligation of the fallopian tubes, as the case may be, by the physician of the institution or one selected by him.¹⁸

The production of efficient individuals means the adoption of many other radical means of improving the human stock. It means that the use of the above-mentioned radical measures must be extended beyond persons who are found in institutions, to include those incompetents and defectives who are at large. The type of defective known as a moron, seldom put into institutions, and yet incurably deficient, represents the group among whom offspring might well be prohibited.

The means of obtaining efficiency that depend upon the determination of what kinds of individuals shall be born, conflict to a certain extent with public sentiment. The history of the sterilization laws during the past 18 years¹⁹ shows a laxity in their enforcement. Of the 3,233 operations performed, 2,700 were cases of insanity, and of the total number of operations 2,960 were performed in only four states, showing relative inactivity in the remaining states that have enacted the necessary laws.

It is, doubtless, justifiable to proceed slowly in such matters, for we are constantly reminded that many of the great characters of history were defective in one or other of the ways mentioned in the preceding pages. But there is no doubt that the pressing character of the problem of deficiency will cause a more widespread limitation of production of possible burdens and menaces to society. The promo-

¹⁸ S. Smith, M. W. Wilkinson and L. G. Wagoner, "A Summary of the Laws of the Several States Governing Marriage and Divorce of the Feeble-minded, etc.," *Bulletin of the University of Washington* No. 82 (1914).

¹⁹ See H. H. Laughlin, "Eugenical Sterilization in the United States" (Psychopathic Laboratory of the Municipal Court, Chicago, 1922).

tion of measures for the prevention of the birth of undesirable individuals should not detract from the more positive and equally important function of preserving and multiplying the fit individuals. A sound eugenics program²⁰ must include both means of improving the human stock. The delayed marriage of college-trained people and the decreasing birth rate among the more intelligent portion of the population are only two of the problems that are attracting increasing attention because of their serious social consequences. The suggested remedies have varied from the reduction of the time required to qualify for the professions and for earning a livelihood, to the subsidizing of the fit with government funds. The nearest approach to a remedial measure, on a small scale to be sure, is the provision of generous scholarships for scientific workers who have completed their academic training.

²⁰ For such a program see C. B. Davenport, *Heredity in Relation to Eugenics* (Henry Holt and Co., New York, 1911).

CHAPTER IV

EFFICIENCY AND LEARNING

WE have previously discussed the tendencies of the individual toward activity before he comes into contact with his environment. Since the necessary reactions to environment begin at birth or even before, it is proper to speak of possibilities of certain kinds of behavior or tendencies to action, meaning simply that the first time a stimulus affects the organism a particular response will follow. How are these original tendencies to action modified as a result of environmental influences, or, to put the case more simply, how does one learn?

THE MECHANISM OF LEARNING

We have said that all situations naturally produce a satisfying or an annoying state of mind in the individual and that the organism tends to make movements of random character to retain the satisfying state or to change the annoying into a satisfying state; further, that there is a tendency for the reactions resulting in a satisfying state to produce a more lasting effect upon the nervous system than those reactions which produce an annoying state. Hence, by virtue of these original characteristics of the organism, we have a mechanism by which certain kinds of movements may be selected out of a number of more or less random movements and become connected or associated with a certain objective situation. If the stimulus produces a reaction which is at once pleasant, this form of response becomes easier to repeat when that stimulus is again received. If the stimulus produces a response which is accompanied by an annoying state, then

the random movements occur; and the response which finally produces the satisfying state is the one which is most easily repeated when the stimulus is next received. This principle of learning is commonly known as the "law of effect."

In the form of learning known as the "conditioned reflex," or the "conditioned reaction," the connections between situations and responses may be made without arousing either satisfaction or dissatisfaction. Thus, in the case of the pupillary reflex,¹ the individual is quite ignorant of the changes which are taking place in his reactions. In this form of learning *repetition* of the response in the proper time relation with the stimulus will serve to connect the two, so that on a later occasion the situation will itself cause the response. The process may be illustrated by the conditioning of the salivary reflex of the dog in the familiar experiment of Pawlow. When a piece of meat is shown to a dog, his salivary glands will begin to secrete a copious flow of saliva. If a bell is rung every time the piece of meat is presented to the dog and this combination of circumstances is repeated a great many times, it will happen that ringing the bell without the presentation of the meat will cause the flow of saliva. The response, by repetition, has become associated with a new situation, the ringing of the bell. Associations of this type which are established by mere repetition are very fragile and are characterized by a rapid "wearing out," quite in contrast to the permanence of ordinary learning. When, however, there is a satisfaction or dissatisfaction factor added, as in the conditioning of the fears, or the association of the fright reaction with a new situation, the effect may be permanent. This principle of learning by repetition is known as the "law of exercise."

¹ H. Cason, "The Conditioned Pupillary Reaction," *Journal of Experimental Psychology*, Vol. V (1922), pp. 108 ff. See also J. B. Watson, *Behavior* (The People's Publishing Company, New York, 1925).

The relative importance of these two laws of learning is a matter of dispute. Whether the one or the other be chosen as of primary importance, learning may be reduced to the formation of connections between situations or stimuli and responses or reactions. It consists in (a) the strengthening of some original responses by repeating them, and (b) weakening certain original responses to a given situation and substituting other responses which in turn grow stronger with use.

For convenience of treatment a distinction may be made between the case in which the response consists of a bodily movement and that in which it consists of a change in consciousness, but fundamentally there is no distinction. In one case the objective change is the object of interest and in the other it is the subjective or mental change. The underlying nerve activity is of the same character in both cases. There are some investigators who assert that every response to a stimulus is a movement response, which may or may not be accompanied by consciousness. Pillsbury,² in speaking of the relation between habit and memory, says:

Habits, as was seen, are due to the establishment of connections between sensory and motor neurones by a change that takes place at the synapse. After these have been frequently connected, the stimulus tends to reinstate the act whenever it appears. Retention of ideas has exactly the same basis. The cells involved in the ideas also act together, and this activity produces changes in the synapses. Whenever one of the ideas presents itself again, the other is, or tends to be, reinstated. Not merely the cortical elements are rearoused in memory, but the whole sensori-motor tract may be partially active. This brings the process still nearer to habit. Memory is an habitual response in which the greater part of the activity is in the cortex. The activities of the sense-organ and the muscles are subordinated to the central processes, while in habit the whole sensori-motor tract is active in approximately the same degree.

² W. B. Pillsbury, *Essentials of Psychology* (The Macmillan Co., New York, 1913).

HABIT FORMATION AND THE ACQUISITION OF SKILL

The objective type of learning is variously termed habit, practice, or acquisition of skill. A great mass of experimental work has been done both on animals and on man to determine the fundamental laws of habit formation. A good example of learning in animals is the case cited by Thorndike³ of a house cat learning to escape from a pen to get food.

If we take a box twenty by fifteen inches, replace its cover and front side by bars an inch apart and make in this front side a door arranged so as to fall open when a wooden button inside is turned from a vertical to a horizontal position, we shall have means to observe such [learning process]. A kitten, three to six months old, if put in this box, when hungry, a bit of fish being left outside, reacts as follows: It tries to squeeze through between the bars, claws at the bars and at loose things in and out of the box, stretches its paws out between the bars, and bites at its confining walls. Some one of all of these promiscuous clawings, squeezings, and bitings turns round the wooden button, and the kitten gains freedom and food. By repeating the experience again and again the animal gradually comes to omit all the useless clawings, and the like, and to manifest only the particular impulse (e.g., to claw hard at the top of the button with the paw, or to push against one side of it with the nose) which has resulted successfully. It turns the button around without delay whenever put into the box. It has formed an association between the situation, confinement in a box of a certain appearance, and the response of clawing at a certain part of that box in a certain definite way. Popularly speaking, it has learned to open a door by turning a button.

Much of the learning of human beings is of this crude sort, especially the learning of infants and young children. But even in adults the same selection of the correct movement from a number of more or less chance series of move-

³E. L. Thorndike, *Educational Psychology, Briefer Course*, (Teachers College, Columbia University, New York, 1914), p. 129.

ments is the basis of learning. A young child who is learning to write will make many random movements with his hand and many useless movements of other parts of his body, such as gritting his teeth, scraping his feet on the floor, and sliding around in his chair. When some of the movements produce a satisfying effect, through an approximation to the copy, or the approval of the teacher, these movements get the advantage over all others, so that, when another attempt is made, the correct movements will tend to occur sooner. Finally, when learning is complete, only those movements which aid directly in reaching the desired result are retained.

The results of experimental studies of the learning process are summarized in the following statements:

1. A series of more or less diffuse and random movements leads to chance success. There must be a cause for these random movements. It may be only the natural tendency to be active, or hunger, or interest in some specific task such as learning to write, or to solve a puzzle. Interest is the important factor in the learning of adults.

2. The pleasurable effect tends to stamp in the successful movement more permanently than the unsuccessful, so that, when the procedure is repeated, some of the incorrect and unnecessary movements are dropped off and the right one occurs sooner. In terms of time, there is a gradual reduction of the time necessary to perform the act.

3. The influence of unpleasant effects must not be overlooked. Stimuli which are annoying lead naturally to activity that will continue until a pleasurable result occurs. Thus, if it does nothing more than lead to activity, the unpleasantness would aid in the learning process, since movements of this type are just the sort that give opportunity for chance success. Compared with the direct effect of pleasurable states in establishing a habit, the unpleasant states are sometimes called secondary or indirect aids to learning.

4. Learning, with the consequent reduction in time of performance, is in many cases due not to making the same movements faster and faster, but to making entirely different movements. That is, the habit when formed may consist of a set of movements entirely different from those employed in the beginning. Learning is thus primarily a process of selection of movements.

5. To get a proper conception of the changes which occur in learning, the whole process must be conceived as taking place in the nervous system, i.e., it must be treated as a physiological change. It resolves itself into a modification of conduction units in the nervous system so that a certain stimulus will lead directly to a certain movement. Thus any factors which tend to establish such paths of conduction in the nervous system are of use in learning.

6. It is generally agreed that learning must be spontaneous. And this conclusion naturally follows if our explanation of learning be correct. If one is to learn an act of skill, he must make the movements himself rather than watch another make them, or rather than have his own limbs passively moved by another. Since training is a preparation of sensori-motor conduction paths, the complete paths must be exercised, and this occurs only in active movement. Guiding a child's hand in teaching him to write would then be an inefficient method of instruction.

The acquisition of skill depends upon the same conditions as those just cited. Very careful and detailed studies have been made upon the acquisition of skill in typewriting, in telegraphy, in target shooting and in other similar activities. The most complete of these experimental studies is that on typewriting.⁴ In this experiment every error made and the

⁴W. F. Book, *The Psychology of Skill* (The Gregg Publishing Co., New York, 1925). See also W. F. Book, *Learning to Type: With a Discussion of the Psychology and Pedagogy of Skill* (The Gregg Publishing Co., New York, 1925).

time required for every single operation of the machine were recorded during the course of the learning process. The introspections of the learners were recorded at frequent intervals to aid in interpreting the causes of improvement. The following conclusions to be drawn from this work supplement those derived from the study of the more elementary form of learning described above.

7. The methods by which improvement comes are seldom conscious—one falls into the right way of doing things without knowing what the change is. Any one who has learned to play tennis, golf, to skate or to swim will recall that very often he did not know or could not discover just what constituted the modification in his procedure which changed the unsuccessful into the successful trials. The reason that the successful variations may not be conscious is that the learning consists of changes in the physiological mechanism, hence it would be impossible for one to be conscious of anything but the outward results of the change. In the case of typewriting, certain steps in the process of improvement were discovered. The improvement has been attributed to the “formation of higher units” or the acquisition of larger and larger groups of movement habits. These are series or chains of movements which are set going with as little conscious control as one single movement requires in the untrained person. Thus a skilled typist writes whole groups of letters and even words with one conscious effort, rather than one letter at a time, although each letter always requires a specific movement. So it is that an expert operator can move his fingers in writing faster than they can be followed by the eye, or even faster than they can be followed in thought.

8. After a certain set of responses has once been developed, it is often of value to become conscious of them in order that they may be repeated the more readily when needed. For example, the ability to write certain combina-

tions of letters on the typewriter without attention to the letters comes gradually, and one is surprised to find himself able to do it. To use such higher units efficiently the writer should be conscious of these newly acquired habits, so that he may distribute his attention to the greatest advantage.

9. Improvement often results from the elimination of bad habits and the dropping of useless movements. In most cases these, too, are unconscious changes, which may be discovered after they have been established. Watching a beginner learn any complicated act will reveal a great number of useless and retarding movements, which must be eliminated as practice continues. The greatest efficiency results from learning under such guidance that only *right* habits can become fixed. The value of this is especially clear in typewriting, where one's common sense will not guide him into the most economical procedure, and where, if left to himself, one will form habits which must be broken with more or less difficulty before further progress can be made. It is largely on account of the value of forming right habits from the very beginning of the learning process that instruction has come to play such a large part in the scientific management program.

10. The typewriting experiments show the great value of incentive in helping one to improve. The promise of promotion, the promotion itself, or a desired reward of any kind, will often give the needed spur to one's energy. In the case of telegraphy, men will remain for years at a fixed degree of efficiency, until some unusual stimulus will cause a striking increase in speed. Obviously, such spurs to effort come relatively seldom, but there is a source of interest and incentive available to all learners. That is the incentive which comes from competing with one's own past record. Such self-competition has most of the good points of actual competition and rivalry with one's fellows—which have a strong instinctive basis—with none of their bad points. Any

person who will carefully keep a record of a series of his trials in acquiring skill, either in terms of amount of work done or of time required to do it, and will draw the results out in curve form, will develop great interest in building the curve from time to time and noting its changes. The value of self-competition is being recognized in school work in connection with the "practice method," where such individual records are kept by the children, and in industrial work, where an individual works by the piece method and a record of his daily or hourly achievement serves as a strong incentive to increased effort.

Kirby⁵ used the practice method of teaching arithmetic to a group of 1,350 New York City school children, and compared their records with children taught in the ordinary manner. The children were further compared as to length of their practice periods. In discussing the experiment, Kirby thus emphasizes the importance of knowledge of one's past record as an incentive:

After a practice period was finished and pencils were laid down, the children were eager to tell their own scores and to learn the scores of others. It acted as an immediate reward and so as an incentive. . . . Just before beginning the second and each following practice period, the exact score of each child in the preceding day's practice was read, both the number of columns worked and the number correct. . . . The children were told that their individual improvement was to be measured and they were shown that no matter how low or how high their present record, their final standing would be determined by the amount of gain made. They were shown that it was not primarily a contest among the individuals of the class but an effort on the part of each one to surpass his own previous record. The children were encouraged to compare their last record with their own previous records, and at times the scores were read to them in such a way as to indicate gains made.

⁵T. J. Kirby, *Practice in the Case of School Children* (Teachers College, Columbia University, New York, 1913).

In accounting for the greater improvement in the group whose practice time was divided into rather short working periods, he says:

The group working in shorter periods had a longer time in which to catch the spirit of the experiment, and to become enthusiastic over surpassing their previous performance. They had their own records read to them more times and had the incentives to intense effort repeated more often.

Experimental results indicate that there is no act, except a reflex, no matter how specialized the training may have been in the course of one's occupation, that cannot be improved by practice, under the conditions of the so-called "practice experiment." Typesetters of years of experience are able to improve considerably under practice conditions, and bank clerks who have added figures for years can make striking increases in speed in a few hours of self-competition. The practical application of these facts is obvious.

11. There is a "physiological limit" beyond which our bodily mechanisms will not allow us to go either in speed or in amount of work. Thus the delicacy of our sense organs limits the fineness of our sensory discrimination, the structure of bones and muscles limits our strength, and the conducting mechanism, including the nerve fibers and their central connections, limits the speed with which our movements may follow the stimuli or situations which cause them. For instance, the physiological limit for a movement of the finger in response to the stimulation of the eye by a light of moderate intensity is about one-tenth of a second. But in the great majority of cases, it is not the physiological limit which blocks progress. Most often it is the lack of sufficiently powerful incentives, the presence of wrong movement habits or other remediable condition. According to James,⁶ most of us get into the habit of living on too ineffi-

⁶W. James, *On Vital Reserves* (Henry Holt and Co., New York, 1911).

cient a plane, and could increase our output largely without taxing our organism to the danger point. He says:

Of course there are limits, the trees don't grow to the sky. But the plain fact remains that men the world over possess amounts of resource which only very exceptional individuals push to their extremes of use. But the very same individual, pushing his energies to their extreme, may in a vast number of cases keep the pace up day after day, and find no reaction of a bad sort, so long as decent hygienic conditions are preserved. His more active rate of energizing does not wreck him; for the organism adapts itself, and as the rate of waste augments, augments accordingly the rate of repair.

Just how one may know his real limit, beyond which it is not safe to go, will be discussed in Chapter IX.

EFFICIENCY IN MENTAL WORK

In distinction from the objective form of learning or habit formation, there is the subjective learning or memory. This last is a general term commonly used to cover all such phenomena as retention, recall, association and recognition. The results of the large amount of experimental work on memory may be gathered into a few statements, showing the most economical methods of learning. We are not likely to feel the necessity for economy and efficiency in our mental activities, because we do not commonly think of them as consuming energy. But when one realizes that time and energy are required for mental work just as for physical activity, the need for economy will be apparent.

1. The most efficient learning consists in selecting the particular type of memory adapted to a given kind of material and the use to which it is to be put. The schools in their work emphasize the most difficult kind of memory, an unaided verbatim reproduction. There are certain cases that require this type of learning, e.g., all isolated materials such as the multiplication tables, and the spelling of words. But

there are other kinds of material which should be easily obtainable when required but which need not be carried in the mind at all times. In such cases one need not learn so completely that the facts may be recalled at any time but only well enough that they may be relearned easily when needed. Thus most of our knowledge acquired in our school days has apparently gone completely from our minds, but only a small percentage of the original labor will bring it all back. Much of the education of the engineer, the professional man and the teacher is of this kind.

Then there is much material which need be learned only so well that it will be recalled along with some other definite thing with which it has been associated. The name of a person may be thus associated with the sight of his face, a telephone number with a particular name, a foreign word with the sight of the English equivalent. This type of memory requires much less effort than absolute recall and in its place is just as efficient.

Some things need be remembered only when they themselves are present. This form of memory is called recognition, and it is the most economical of all. It consists simply in knowing a thing or being familiar with it, when we meet it. For instance, it is far more important for one to know his fountain pen when he sees it, to be able to use it, than to know all about it at other times. In what way and how well a thing is to be learned must depend on the use that is to be made of it, for economy of effort demands that the means shall be employed which will be most efficient, and which will require the least expenditure of energy.

2. If a large quantity of material is to be learned, common sense will not enable one to select the most economical method of learning it. Experiment has shown that the material should be learned as a whole rather than in parts. To take an example, if one had a poem of sixteen four-line verses to learn, the correct way to learn it would not be to

learn it one verse at a time, a procedure commonly followed by an untrained individual, but to read from beginning to end again and again until the whole could be repeated. There is only one drawback to this method, namely, that a person is likely to become discouraged or lose interest when progress is apparently lacking, if he does not have sufficient confidence in the method. It sometimes happens that, in first using this method of learning, rather poor results are obtained, but if given a fair trial, the time saved and the greater permanence of the result will show the real efficiency of the method.

The reason for the greater economy of the "whole method" lies in one of the most fundamental laws of learning, namely, that one should always begin by doing a thing as nearly as possible in the way it is eventually to be done. Otherwise, it must not only be relearned in parts, but old habits must be broken. In learning anything in sections, associations are formed between the end of a section and its beginning, but since repetition as a whole is the desired end, all such associations must be finally broken and correct ones formed. Learning the task as a whole in the first place forms only habits which will be needed in the perfected performance.

3. A third fact in economical learning has to do with the distribution of time and effort. If the exact influence of fatigue, practice and a number of other factors involved in learning were known, one could arrange beforehand the time schedule that would be most economical for learning. But since we do not have such knowledge in sufficient detail, the problem has to be attacked empirically. Various tasks are set and a given amount of time allowed for learning. This time is differently distributed for different individuals, some spending theirs in one continuous work period, and others dividing it into portions separated by unoccupied intervals. The conclusion which has been drawn from experiments of this type is that too great concentration or

distribution of time is not economical. The learning periods should be short enough to avoid the onset of fatigue, and long enough to avoid the loss of too much time in getting warmed up to the task at the beginning of each learning period. No absolute rule can be laid down for all individuals, but it can be safely said that a moderate distribution of time always gives more economical results than spending the same amount in one continuous study period.⁷ The same facts are true of motor learning or muscular activity. The reason in the latter case seems more obvious than in memorizing, but it is no doubt the same in both cases. Activity causes an increase in the nutrition of the part used, and these nutritive changes, whether they occur in the nerve or in the muscle mechanism, would be facilitated by a distribution of the working time.

4. The permanence of the effects of learning has been measured for various sorts of material and for fairly long periods of time. Naturally, the duration of the effect of learning depends much on the character of the material, e.g., whether or not it is logical in character, and whether or not it is related to one's permanent interests. But allowing for all these possible variations, the effects of learning fade out in relatively the same manner, whatever the nature of the material learned. Thus, it has been definitely established that forgetting goes on very rapidly for a short time after learning and then more slowly until the passage of months or even years does not seem to reduce the quantity retained. A necessary corollary to these facts about forgetting is that of the value of repetition in learning, or reciting from time to time what has been learned. The most economical time to do this repeating is during the period

⁷ A notion of the complexity of this problem may be gained from E. S. Robinson, "The Relative Efficiencies of Distributed and Concentrated Study," *Journal of Experimental Psychology*, Vol. IV (1921), pp. 327 ff.

shortly after the learning, because this is the critical period in which a large proportion of the material, if not refreshed, will be lost. The laboratory experiment which indicates the slowest rate of forgetting, shows that, of a poem learned well enough to be repeated correctly twice immediately after learning, over 20% will be lost in 24 hours, while at the end of 30 days only 76% will be lost. These figures mean that, in a period thirty times as long, less than four times as much of the material is lost. The results of other experiments with different kinds of material show a much greater difference in the rate of forgetting during the different time intervals.

5. One of the most important conclusions to be drawn from experimental work on learning is the necessity for the intention or the "will to learn," in order that things shall be remembered. The case is analogous to the active as compared with the passive attitude in habit formation mentioned earlier in the chapter. Any one can find abundant evidence from his own experience that only the things which he intends to learn are likely to be remembered. For instance, the writer has in the course of certain experimental work named a series of 100 colors (five different colors, each repeated twenty times, arranged in a random order) over 1,000 times in order to measure his speed of reading, and he never learned the list so far as to be able to recall even the first three colors. Here the intention was to gain speed in reading and not to remember. One's ignorance of situations which he meets daily during years of his life testifies to the importance of this intention to learn. The inability to describe correctly the face of the watch which one has carried for years is one striking example.

The experimental studies of "incidental" memory⁸ have

⁸ See G. C. Myers, "Incidental Memory," *Archives of Psychology* No. 26 (1913); and S. M. Shellow, "Individual Differences in Incidental Memory," *Archives of Psychology* No. 64 (1923).

demonstrated the correctness of more casual observations upon the need for the intention to learn. No small proportion of the success attained through the use of mnemonic systems comes from the incentive thus created to pay attention to the material to be learned.

6. Just as there is a physiological limit to our speed of action or our endurance, so there is a limit to our learning power, set by the original character of our nervous mechanism. What one's training does is to enable him to make the best use of his native memory, by teaching him the value of various aids to memory such as we have been discussing in these pages. Original differences in retentiveness may account for the great individual differences in the memories of adults.

THE ADOPTION OF SIMPLIFIED SYSTEMS

One of the greatest economies in learning comes from the adoption of simplified systems of material, such as spelling and measuring, in place of more complicated and unwieldy ones. It has been estimated,⁹ for example, that a system of simplified spelling would save approximately two years in the school life of a child. The value of the saving thus estimated, in terms of ability to read at an earlier age, of time available for other projects and in terms of preparation for a life work shortened by two years, is difficult to compute.

Even greater economies are promised from the adoption of a simplified system of measurement, such as the metric system. "Counting the English units bearing the same names as our own, we have in use 4 different sizes of pints, quarts and gallons; 3 different sizes of gills; many sizes of barrels; and untold numbers of different sizes of bushels of things in different states, such as apples, potatoes and the

⁹ F. B. Gilbreth, "Wealth from Standardization: A Typical Example in Simplified Spelling," *Bulletin of the Society of Industrial Engineers*, Vol. V (1923), pp. 3 ff.

like; 3 kinds of ounces, drams and pounds; 2 different sizes of hundredweight, 4 different tons and 2 or 3 kinds of miles." It has been estimated that the United States spends unnecessarily each year 315 millions of dollars in teaching the old system of weights and measures and that a child of ten years who knows the decimal ratio can learn the essentials of the metric system in ten minutes. Similar economies could be attained in other directions, if attention were directed to gaining economy in learning, and with no decreased efficiency in other respects.

THE FUNCTION OF IMAGERY IN LEARNING

There is no one question concerning consciousness in which people seem to differ more than in the importance they attach to images or mental pictures in learning and thinking. Some persons have very vivid imagery and find it present in consciousness so consistently that they make memory and the presence of images of past experience practically synonymous. To such persons, one way to improve memory and learning power is to cultivate a rich and detailed mental imagery. To others, such imagery is almost unknown and consequently seems valueless for mental operations. To Francis Galton and many others since his time, people seem divisible into types according to the character and richness of their imagery. The most significant fact in the work of Galton¹⁰ is the relative paucity of images found in scientific and abstract thinkers, and its great prominence in children.

A question of particular importance to the applied psychologist concerns the value of imagery for special kinds of work. For instance, does the inventor need vivid visual imagery so that he may see in his mind's eye the thing that he shall construct; do the painter and the sculptor need vivid

¹⁰ F. Galton, *Inquiries into Human Faculty* (E. P. Dutton and Co., New York, 1869).

and detailed imagery from which to copy their creations; does the musician need to have auditory imagery to create and reproduce music; is any workman benefited by his ability to get good mental pictures of his task and his attitude toward it? It is difficult to draw a perfectly definite conclusion as to the practical function of imagery. But careful investigations indicate that persons lacking these images altogether, or possessing them in such vague form as to make them seem useless, have been eminent in the activities mentioned above.¹¹ Furthermore, individuals who can demonstrate that they rely on these images in learning are rare. So far as the present state of our knowledge permits us to judge of the matter, it would seem to be a waste of time to cultivate imagery as an aid to learning or as a source of mental efficiency. And it would be absurd to select individuals for special types of work upon the basis of their imagery, either as to its character or its vividness.

TRANSFER EFFECTS IN LEARNING

In studying efficiency in mental life one frequently encounters this question: Is there a general ability or intelligence which is trained and developed in the course of experience, or is training specific in its effects, modifying only the function exercised? Our educational systems have been built upon the assumption that there is a general intelligence which is subject to improvement, and that such studies as algebra, Latin and Greek are especially valuable for this general training. Exact measures of the effects of training in simple mental and motor activities, supported by the modern conception of the functions of the nervous system, tend to support the view that training is specific, affecting only the function exercised. The problem is a rather complex

¹¹ For an introduction to the literature on thinking without images see R. S. Woodworth, "A Revision of Imageless Thought," *Psychological Review*, Vol. XXII (1915), pp. 1 ff.

one, since a function like memory as we speak of it in a practical sense may correspond to a large number of separate functions in the nervous system. The methods of studying this problem of transfer may be illustrated by the description of a simple experiment.¹²

From a series of 500 numbers, persons were practiced for ten days in canceling out every 3 and every 5 that they could find. They had been previously tested for their speed in canceling from a series of number-groups, every group containing combinations of 3 and 5, and combinations of 4 and 7. After the ten days' practice in canceling 3 and 5 separately, the group cancellation tests were repeated. It was found that in the canceling of the groups containing 3 and 5 there was a gain equal to more than 50% of the gain in the task actually practiced, that is, the transfer effect was 50%. But in canceling groups containing 4 and 7 there was no gain whatever to be attributed to practice. In the one case we find identical elements, the numbers 3 and 5, responsible for the transferred improvement, and in the case of the numbers 4 and 7 there were no identical elements, and no improvement. This means that there was no improvement in the general ability to cancel numbers, but only in the ability to cancel specific numbers or groups of numbers. This particular experiment and its results are typical of those performed by numerous investigators.

In response to the growing conception of the limitations of general training, one can see a natural reaction in educational procedure, a reduction in the emphasis upon purely cultural studies, with an increase of emphasis upon vocational and practical aspects of training.

¹²A. T. Poffenberger, "The Influence of Improvement in One Simple Mental Process upon Other Related Processes," *Journal of Educational Psychology*, Vol. VI (1915), pp. 459 ff. For a recent and thorough study of this problem, see Thorndike, E. L., "Mental Discipline in High School Studies," *Journal of Educational Psychology*, 1924, 1 ff and 83 ff.

The problem, as it should be stated to-day, is not whether specific training spreads to all other functions, but to what extent, and whether the amount of spread is sufficient to warrant the time and energy spent in general training. No complete solution has been reached to cover all cases, but there is a conclusion which may be safely drawn, namely, *that one gets the best results from practicing the act he wants eventually to perform, and in the way that he wants to perform it, and is benefited by other related acts only so far as there are common elements in the two acts.*

INDIVIDUAL DIFFERENCES IN THE EFFECTS OF TRAINING

There is an important question concerning the effects of uniform training upon differences among individuals. Does uniform training make people more alike or more different than they would have been without it? The question as stated would be answered differently by persons who attach much or little importance to heredity as compared with environment. To the former, training or practice would only give opportunity for original qualities to show themselves, and hence would result in increased differences; while to the latter, similar training would produce greater uniformity. The matter has been attacked experimentally, in the case of very simple mental operations, such as calculations and speed of perception, but the results are difficult to interpret. Differences at the beginning of training may be due to differences in the extent to which the particular function has been previously trained, or to actual differences in original capacity to learn. The effects of practice would be different in the two cases. If the differences at the beginning of practice are due to inherited capacity, then practice would increase these differences; but if the differences before practice are due to differences in training, the individual with little previous training would be given the opportunity to acquire it, and the individuals would become more similar.

It is practically never possible to evaluate the factor of previous training in experimental tests, since no one ever begins training in any function at the zero point of efficiency, nor can it be assumed that two or more people begin the training with the same preliminary preparation. About all that the practice tests show thus far is that the relative position of the individuals of a group at the beginning of practice does not necessarily indicate what their relative order will be at the end of practice. The one who begins best may, at the end of practice, be the best, or may drop to an inferior position and be supplanted by one who began with an inferior grade of performance. This is especially the case where practice continues until ultimate ability is approximated. The variation in position is due to the interaction of previous training and original capacity, and perhaps also to such factors as change in the attitude of the individual toward the work, or loss of interest. Expressed in terms of coefficients of correlation, reported by Thorndike, the relation between relative position at the beginning and end of practice is for a group of 28 persons tested in mental multiplication $+ .48$; and by Hollingworth¹³ the same relation in the case of a number of simple mental tests on a group of 13 individuals is $+ .42$. This latter figure is the average of separate correlations, and the author emphasizes the fact that the different tests included in the group do not all show the same relations. The relation between beginning and end of practice represented by a correlation of $+ .40$ to $+ .50$ indicates changes in position about half as great as would occur by pure chance.

The practical conclusion to be drawn from this type of experimental work is that one should be cautious in judging

¹³H. L. Hollingworth, "Individual Differences Before, During and After Practice," *Psychological Review*, Vol. XXI (1914), pp. 1 ff. See also G. S. Gates, "Individual Differences as Affected by Practice," *Archives of Psychology* No. 58 (1922).

ultimate capacity of an individual from any sort of preliminary test. The conclusion agrees with one quoted from Thorndike earlier, that the college marks of one's older brother in his senior year are a more reliable index of what the individual himself will do in his senior year, than are his own college entrance examinations.

THE EFFECTS OF TRAINING UPON INDIVIDUAL VARIABILITY

A further question may well be asked, concerning the influence of practice upon the variability of each individual's performance. It is well established that practice decreases the variability of an individual, makes his performance more uniform. In fact this may be considered a matter of common observation. The variability is reduced by trimming off all superfluous and wrong movements, leaving fewer factors to vary. But even when this has been done, variations in performance are not completely eliminated; there will always be slight variations in speed and accuracy. The question then arises whether there is an actual reduction in the variation of the movements still retained as a part of the performance, or whether the reduction is only apparent and due to the elimination of the useless movements. In studying this matter, statistical errors are likely to creep in, since if variability is calculated on the basis of the time required to do a unit of work, it is much reduced by practice, but if calculated on the basis of quantity done in a given time, the variability increases with practice. In concluding as to the change in the character of one's work as a result of practice, the figures must not be taken at their face value, but must always be interpreted in the light of the method of deriving them.

CHAPTER V

THINKING

HABITS, whether they are motor habits or habits of mind, have the character of routine implied in them. They have been developed in the course of a series of repeated reactions. Well-established habits closely resemble instinctive responses, so much so that it is frequently difficult to distinguish between natural and acquired responses. When a certain situation is presented, a series of habitual responses may occur without the intervention of conscious control. In fact, consciousness of the response may be entirely lacking. Most of the situations of everyday life are met in this semi-automatic fashion. It is well that this is so, for habitual action is by far the most economical form of behavior. But all of our behavior cannot be of this routine sort. The human environment is so complicated, that new and strange situations are sure to arise for which no habitual responses have been established.

THE NEED FOR THINKING

When obstacles or difficulties interfere with the smooth flow of habits, then consciousness comes to the rescue. When the situation is perceived, some slight shift in the series of habits may be all that is necessary. But when no ready-made response occurs, the human being is said to think, to reason, to judge what to do. A new adjustment to this strange situation must be created. It is this capacity for adjustment to a changing environment that is said to distinguish man most clearly from the animal. Whether

this statement be strictly true or not, the thinking form of human reaction may be illustrated most readily by contrasting it with the behavior of an animal when placed in a new and unusual situation.

When an animal is placed in one of the puzzle boxes used for studying learning, it attacks the problem of escape with many or all of its natural and learned reactions. These are applied in a random, haphazard fashion, wrong movements being repeated again and again, until one movement or series of movements happens to meet the situation and makes escape possible. Or, in the absence of the correct reaction, the animal may fail entirely to solve the problem. This form of behavior is familiar to us under the name of "trial and error." When a human being is made to face a similar problem, such as the need to escape from confinement, he may meet it just as the animal does, by "trial and error." Or he may use a kind of mental "trial and error." Here the various reactions are tried out in consciousness, one by one in systematic fashion, the unsatisfactory responses which are suggested being discarded before they become overt acts. The only overt motor response may be the one that correctly meets the conditions of the problem. The most striking difference which an observer would note in the behavior of the man and the animal would be the absence of motor manipulation in the case of the former. This case represents a kind of ideal fashion of solving a problem, for the customary difference would be that the human makes relatively fewer and less random movements than the animal rather than none at all. In fact the study of human behavior in the presence of puzzling situations reveals instances ranging all the way from the animal method of attack to the relatively rare case such as cited above. The majority of cases would fall somewhere between these two extremes.

In dealing with strictly mental problems where overt

action is entirely absent or long delayed, the thinking process differs from the "trial and error" process mainly in the systematic character of the trials. That is, the wrong response is not repeated again and again as in animal learning, but when tried and found wrong it is permanently discarded. Thus the range of possible reactions is gradually narrowed down until only the correct response remains.

Thinking, therefore, is not a unique mental operation differing from all others and superimposed upon them, but, on the contrary, partakes of the nature of the simpler forms of behavior. Hollingworth,¹ who approaches the problem of thought by way of sleeping and dreaming, with which it is usually sharply contrasted, says: "In sleep thought ceases; in drowsiness, thought is seen making headway with the most meager equipment; in the dream the nature of thinking is so clearly exhibited that only waking reflection can rob dream verdicts of their coerciveness."

STAGES IN THE THINKING PROCESS

An examination of this mental trial and error process will reveal the conditions upon which effective and economical thinking depends. The following illustration² affords excellent material for this study. A certain individual crossing a river on a ferry-boat noticed a long pole painted white, bearing a gilded ball upon its end and projecting nearly horizontally from the upper deck. At once a problem or difficulty arose in his mind, namely, what is the function of that pole? Possible answers to the question began to crowd into his mind—memories of earlier experiences of somewhat similar objects. Each answer or suggestion was examined and tried out to determine whether it was an ade-

¹ H. L. Hollingworth, *The Psychology of Thought* (D. Appleton and Co., New York, 1926), p. 14.

² Adapted from J. Dewey, *How We Think* (D. C. Heath and Co., New York, 1910).

quate solution or not. These suggestions and the methods of trying them out were as follows:

1. It is a flagpole. The color of the pole, its shape, the presence of the gilded ball upon its end made the suggestion of flagpole acceptable. But the position of the pole seemed to be a very unusual one for a flagpole. Furthermore, there was no visible means of attaching the flag to the pole, such as a ring, pulley or even a cord. And finally, there were two other vertical poles, each carrying flags. If this were a flagpole, it, too, would be bearing a flag. This suggestion of flagpole as a solution of the problem was considered inadequate and was rejected.

2. It is an ornament. The general appearance of the object made this suggestion acceptable as it conformed to earlier experiences of ornaments. But memory and observation supplied the further information that all sorts of river craft carried the same kind of poles. Among these were tug-boats and freight boats which showed no other attempt at ornamentation. These objections were sufficient to overthrow the suggestion as a correct solution to the problem.

3. It is the terminal of a wireless telegraph mechanism. Such terminals, however, usually occupy the highest available point and have wire attachments of some sort. There were no wires visible. In addition, there would seem to be no good reason for equipping all tug-boats, ferry-boats and other river craft with wireless apparatus. Finally, memory supplied the information that boats carried this sort of pole before wireless telegraphy was invented. Therefore, this suggestion could not be accepted.

4. The pole might be a device to aid in steering the boat. In support of this suggestion it was noted that the pole was so located that the ball seemed to be projected in front of the pilot house where the pilot could easily see it. The pilot being located on the front of the boat would need some form of guide as to the direction in which it was

traveling. Here is a device that might be used to guide the boat somewhat as the gunner uses his gun sight in order to aim. Thus its position could be accounted for. As all boats would need some kind of aid in steering, the presence of such poles on all boats would be accounted for. The white color and the gilded ball on the end could be explained as a means of increasing the visibility of the steering device. The suggestion that the pole was a steering device seemed to fit all the conditions of the problem and was consequently accepted as the correct solution.

THE DEMANDS OF CORRECT THINKING

This simple illustration of an ordinary adjustment to a strange situation contains all the elements of the thinking process.

1. First, the problem or difficulty must be clearly perceived. Where no problem is observed there will be no thinking and where the problem is not clearly perceived the thinking will be erroneous. In the example above, if it had not been observed that the pole lacked rope, ring and pulley, there might have been an immediate acceptance of the idea of flagpole.

Since thinking is difficult and since such a large proportion of our behavior is of the habit sort, there is a tendency to see no problems, but rather to accept the first suggestion that occurs, or to interpret each new and strange experience as though it were an old one. It is a characteristic of some minds that they have a mental habit reaction for every new problem. Minds of this type are said to be in a rut. The consequences of such a substitution of mental habit for thinking on the part of all people are elaborately set forth by Robinson.³

It is not always mental laziness that is responsible for the

³J. H. Robinson, *The Mind in the Making* (Harper and Brothers, New York, 1921).

failure to see problems. In many cases training is necessary. A scientific training is, in some measure at least, a training to see problems. The geologist sees problems in rock formations, the botanist in flowers, the chemist in metals and soils that would escape any but such a trained observer.

2. Correct thinking implies a rich and varied experience. In the simple case cited, there were memories of flagpoles and their customary position and equipment; of decorative devices and where they are commonly used; of wireless telegraph apparatus, its usual character and position, and of the approximate time that wireless telegraphy was invented. The great drive toward collecting useful information is known as the instinct of curiosity, an impulse that varies considerably in strength in different people. "The curious mind is constantly alert and exploring, seeking material for thought, as a vigorous and healthy body is on the *qui vive* for nutriment. Such curiosity is the only sure guarantee of the acquisition of the primary facts upon which thinking must be based. The most casual notice of the activities of a young child reveals a ceaseless display of exploring and testing activity. Objects are sucked, fingered and thumped; drawn and pushed, handled and thrown; in short, experimented with till they cease to yield new qualities. Such activities are hardly intellectual and yet without them intellectual activity would be feeble and intermittent through lack of stuff for its operation."⁴

The important part played by tests of range of information in our intelligence tests would be justified if they were looked upon merely as indicators of the presence of the stuff on which thinking must depend.

3. The experiences must be remembered in such an orderly fashion that they will be recalled when needed. Through natural curiosity and training there is accumulated

⁴J. Dewey, *How We Think* (D. C. Heath & Co., New York, 1910), p. 31.

the subject-matter from which the suggestions for answering questions and solving problems must come. It is a fundamental condition of thinking that the subject-matter be accumulated, but even then the suggestions may not come. Their appearance will depend largely upon the systematic and orderly arrangement of one's memories. If, in the illustration given above, the previous experiences had not been recalled, thinking would have failed. Since all recall depends upon the functioning of associative mechanisms, the necessity of establishing numerous associations is apparent. Experiencing should be a process of assimilating, of relating new to old, of noting similarities and differences between new and old. Each one of these operations means forming additional sets of associative connections and thereby increasing the chances of recall in a variety of circumstances. Unless one's memories are orderly and systematic and variously interrelated, he cannot be sure that all fruitful suggestions will be submitted for the solution of a problem.

4. Each suggestion must be carefully tested to determine whether or not it satisfies the conditions of the problem. To withhold decision until all the evidence has been submitted and tested is often an irksome task. If in the above illustration the first, second and third suggestions had not been carefully checked against observed facts, the conclusion would have been in error.

There is another prevalent interpretation of the thinking process according to which the outcome of thought is less under the voluntary control of the thinker than the description just given would imply. Wallace,⁵ for instance, describes four stages in the thinking process, namely, preparation, incubation, illumination and verification. The first stage corresponds to the accumulation of data, and refers particularly to the preparation for the solution of

⁵G. Wallace, *The Art of Thought* (Harcourt, Brace and Company, New York, 1926).

a specific problem. Verification corresponds to the task of testing suggestions as described above. The other two stages, incubation and illumination, refer to the process by which the suggestions or trial solutions come to mind. These two terms are employed to describe the surprising fact about thinking that solutions to problems frequently come when least expected, when no effort is being made to solve them, and when the problems themselves have been apparently forgotten. The happy suggestion may come during a ramble through the woods, during strenuous mountain climbing, in that hazy state of mind which occurs when one is about to fall asleep, or even in dreams. Thinkers vary in the means which they find most effective for encouraging and eliciting these "flashes" of thought.

The process of incubation of the ideas takes place in the subconscious, according to Wallace, and little can be done to control its course voluntarily, except to provide the circumstances that in the particular individual are known to be conducive to such incubation, and to be prepared to recognize the "flash" when it comes, and record it before it fades away. After the voluntary stage of preparation has been completed and all the material bearing upon the problem has been absorbed, it is well to drop the matter, to rest from mental labor or to take up the solution of some other entirely different problem, and accept the illumination, if it comes. Naturally, not every idea thus discovered proves to be a correct solution and rigid examination is required in the process of verification.

INDIVIDUAL DIFFERENCES IN THINKING

How shall we explain the great differences among people in their capacity to think and in the value of their thinking? The mind of the genius works much the same as the ordinary mind, and the steps in his reasoning are the same. There may, however, be differences within every stage of

the process. One great difference appears in the number of suggestions that come to mind, in the varied relationships that are noted between the problem and previous experiences. A problem would suggest to the mind of the genius many recollections and "ideas" that would seem to the ordinary mind to have no connection whatever with the problem in hand. Such differences rest in part upon differences in natural curiosity which drives the individual to find out about things and to look for relationships.

Another difference has to do with the speed and facility with which the suggestions come. In some persons the suggestions come to mind with great rapidity and in others they come very slowly. On the whole, abundant and easily flowing suggestions are necessary to good thinking, but it sometimes happens that so many suggestions crowd into the mind that there is an inability to select among them and try them out. There is such a condition in thinking as never being able to reach a conclusion because of the impossibility of giving all suggestions an adequate test. The best thinking results from neither too few nor too many suggestions.

That the quality of the suggestions is more important than their number or the speed with which they are presented must be granted. Some suggestions may be extremely shallow and represent only the most superficial relationships, while others are fundamental and appropriate. Now, the quality of the suggestions depends to a great degree upon the manner in which the material is originally experienced. If only superficial characteristics of a situation are perceived and made a part of one's mental stock, the suggestions coming therefrom will also be superficial. But if one's natural curiosity and training lead him to carefully analyze and examine facts as they are presented, the suggestions arising to meet problems will be not only more numerous but of greater value. Intuition, as the term is popularly used, is

probably nothing more than having only relevant and pertinent suggestions offered as material for meeting new and strange situations. Contrasted with intuition of this sort are the ravings of the insane. Their ideas are the results of the functioning of associative mechanisms, but the associations are of the most superficial sort, frequently nothing more than connections based on word sounds. Such material is worse than useless as far as correct thinking is concerned. Most people's thinking lies somewhere between these two extremes, where much material that is superficial and useless is recalled but is at once rejected and not allowed to slow down the process of examining the relevant suggestions.

There may be innate differences in mental constitution, too, which foreshadow the ability to incubate ideas. Until, however, our knowledge of those activities which are at present assumed to occur in the subconscious is illuminated by a proven "flash," it seems sufficient to account for them in terms of a voluntary and thorough organization of data, an overpowering interest in getting an answer, sufficient leisure to foster the processes of association, and to note all the ends to which such associations lead.

Finally, there are great differences in the care with which the suggestions are tested. Genius has been defined as the "capacity for taking infinite pains," and it is here that tedious and painstaking labor must be expended. It is said that great inventors have been known to try out thousands of suggestions of possibilities before finding a correct solution to some puzzling problem. In contrast to this is the ready acceptance of the first solution that old habits and attitudes of mind will suggest, which characterizes ordinary and careless thinking. Careful and systematic examination of relevant ideas is at the bottom of most great achievements of thought.

THE BASIS OF OPINION

Although it appears from our discussion that the fundamental processes in thinking are based upon inherited characteristics, much can be done to develop and modify these native tendencies through the formation of the proper mental and motor habits. The need for better thinking is everywhere evident. Our opinions, our beliefs, our judgments and convictions about matters of everyday life have been built up out of such a procedure as we have described, sometimes more complicated in the number of suggestions that are offered and examined, and sometimes very much simplified and contracted in one or other of the stages leading to a conclusion. What chance is there that our opinions, thus formed, are sound? Take such questions, for example, as woman suffrage, prohibition, the platforms of political parties, the League of Nations, a protective tariff and an infinite number of simpler matters about which everyone is supposed to have an opinion.⁶ In forming an opinion, one should put to himself the following questions:

1. Do I rightly understand the question?
2. Is my experience with the matter in question sufficiently broad, as the result of reading or other contacts, to enable me to have fruitful suggestions or "ideas"?
3. Do the suggestions that occur to me exhaust the fund of my relevant experiences?
4. Have I thoroughly tested each suggestion in relation to the problem?

Only when an affirmative answer can be given to each of

⁶ For an analysis of public opinion on such questions, its origin and its consequences, see W. Lippmann, *Public Opinion* (Harcourt, Brace and Howe, New York, 1922); see also G. Wallas, *Human Nature in Politics* (Constable, London, 1908). For an application of the facts of correct thinking to business, see M. T. McClure, *How to Think in Business* (McGraw-Hill Book Co., New York, 1923).

these questions can reliance be placed upon our opinions. Obviously, our opinions on most of the questions of the day, such as those cited above, cannot stand this searching examination. The proper attitude should then be that of open-mindedness, a willingness to wait for further evidence, rather than a final acceptance of one or the other point of view. Along with this there should go a recognition of the possibility of the appearance of new evidence which will require the readjustment of many well-established conclusions. The world of knowledge is constantly expanding and our opinions should be fluid enough to permit the changes which such growth entails.

RATIONALIZATION

Thinking is seldom a cold process of pure logic, but tends to be warmed by the trend of our desires. We *want* a preconceived solution to be the correct one. This undercurrent of desire may determine the course of thought at almost every stage. It may give a favored position to the suggestions leading toward the desired conclusion so far as recall is concerned, and may warp the testing of the suggestions so as to give undue weight to whatever will conform to desire. Innumerable examples of such "controlled" thinking may be found in the realm of religious ideas. Thinking of this sort, which may or may not be erroneous, has been called rationalization. A case of such thinking is reported by Leuba:⁷

I know a laborer who is tormented by the desire to make money. Some time ago, he showed me a heavy mass of dark gray sand which he had extracted from the bottom of an old well. He thought the sand contained gold, and had spent much time and money in order to establish the truth of his belief. A desire for wealth was at the root of this man's conviction; but the desire

⁷ J. H. Leuba, *The Belief in God and Immortality* (Sherman, French and Co., Boston, 1916), p. 127.

alone would not have suggested the idea that the sand contained gold. It was of great weight and he had, moreover, observed in it brilliant yellow particles. Therefore, even though many reasons were urged against his conviction, he believed that he had found gold. He did not, of course, rest content at this point. He wanted a scientific demonstration of the truth of his belief, and accordingly he had the sand analyzed. When a reliable chemist reported the absence of gold, he placed samples in other hands. Despite several concordant negative analyses, this man has not yet altogether given up hope.

It is possible, too, that the feelings may play a different and more significant part in the processes of thinking. According to Wallace, they may serve as a kind of warning or signal that an illuminating idea is about to burst into consciousness. In comparing the English type of thought with that of the French, he says that the English are led to change their minds readily when they find that they *feel* differently about a situation. The feeling in this case is the sign that the process of incubation has come to its climax. The result may appear illogical and yet it rests upon the data at hand. It is, however, not a case of rationalization, as defined above, since the feeling does not influence nor direct the course of thought.

CHAPTER VI

SUGGESTION

It was pointed out in the preceding chapter that thinking is difficult and laborious and that it is used only when necessary to overcome obstacles that cannot be met by means of an habitual response. There is one other way of avoiding the thinking reaction, which serves as a short cut to conclusions about matters of everyday life. It consists in accepting, without critical examination, the conclusions of some other person. This is most often done where an opinion has been expressed by one who is considered an authority, as a teacher, preacher or public speaker, or where it is printed in a book or newspaper. Although in many matters of no great importance it may be advisable to accept the opinions of others without testing them, it is a bad mental habit to do so generally. Authorities have been known to be wrong and much that is printed and spoken cannot be considered authoritative.¹

THE NATURE OF SUGGESTION

Suggestion is the term usually applied to the uncritical acceptance of an idea coming from another person. And people are said to be more or less suggestible according to the degree to which they are governed by the ideas of others.

¹ The practical uses of suggestion in education are discussed and illustrated in M. W. Keatinge, *Suggestion in Education* (Black, London, 1907), and G. C. Myers, "Control of Conduct by Suggestion: An Experiment in Americanization," *Journal of Applied Psychology*, Vol. V (1921), pp. 26 ff.

It will be recalled that in the previous discussion of thinking the term "suggestion" was used in a somewhat different sense. There the name was applied to the "ideas" that were suggested as the solution of a problem regardless of the source of these "ideas." Both meanings may refer to the same idea, but in the former or more technical sense, suggestion implies an acceptance of the idea which is not implied in the second case. This technical usage of the term "suggestion" will be presented more clearly in what follows.

Suggestion as a means of controlling behavior is very likely to be looked upon as a mysterious and occult operation, on account of its frequent association with the phenomena of hypnotism, hysteria and the treatment and apparently marvelous cures of disease. In reality suggestion, as stated above, is a very common occurrence in the life of every normal individual and has an important practical bearing. The tendency to be suggestible is either to be considered one of the instinctive tendencies or a complex of several of them. It certainly has some of the characteristics of a native trait, being present in all human beings independently of learning, being variable in strength from person to person and capable of modification through training. Through the power of suggestion under properly controlled conditions, a normal person may be made to feel changes of temperature where there are none, he may be made to see motion in an object that is motionless, or he may be made to experience a difference in weight between two objects when they weigh exactly the same.

Suggestion has been technically defined as the entrance into the mind from without of an idea or image which is accepted uncritically and which tends to produce the volitional and muscular activity which ordinarily follows the presence of such idea or image in the mind. The three facts to be noted in the definition are: (1) That the idea tends to lead to action. (2) That in suggestion the idea

enters the mind from without. (3) And that the idea is accepted uncritically. These three points will be considered in some detail.

1. That ideas tend to lead to action is simply a restatement of the law of association so familiar in connection with learning and memory, namely, that if two objects are associated in the mind at any time and later one of them appears, the other will tend to appear also. One of the items so associated in the mind may be the thought of a movement and the other may be the movement itself or the motor discharge necessary to bring about the movement. Any object may be bonded to any other provided the laws for the formation of associative connections are complied with. If I am sitting quietly at home in a comfortable chair and I hear the sound of a certain bell, it produces in me a state of mind which leads to the act of going to the telephone. In the course of frequently repeated experiences this particular act has become associated with the experience of the particular sound. If I hear the sound of a certain other bell, while sitting in the same chair, I will go to the dining-room instead of to the telephone. Frequent experience in the past has established an association between the sound of this bell and the act of going to dinner. When one item of the pair thus associated comes to mind, the other will tend to come also. The action following the presence of an idea in mind may be much simpler or more complex than the cases just cited. It may not in every case be an action adequate to handle the situation of which one has an idea. But there is a tendency toward movement of that sort. Think intently of your necktie and you will find yourself fingering and adjusting it. Concentrate on the choice cigar in your pocket and you will be likely to reach for it. Vividly recall the pleasure of a warm bath, or the tremendous wind currents of lower Broadway and you will find yourself either stretching out your legs, closing your

eyes and reclining in your chair, or as the case may be, ducking down into your coat collar and clutching your hat brim. And the more you attend to the idea in mind the more completely will it tend to issue in a motor reaction.

The mystifying phenomena of the planchette or ouija board and the so-called muscle reading are further manifestations of this law of association. When two persons sit with their finger tips resting lightly upon the little table of the ouija board and one of the persons thinks intently of some word or name, the little table will begin to move and will slowly spell out the name by passing from one letter to another. It is driven by the slight movements of the finger muscles in accordance with the ideas in mind. It must be noted that the idea need not be the idea of moving from one letter to another, but simply the experience of the word or letters. Associated with these ideas of the letters is the tendency to move toward them. The person who is controlling the movements of the table may not be conscious of the associative connections or even of the movements themselves because they are so slight.²

2. The form of behavior just cited is not called suggestion, although the mechanism is just the same. About the only distinction is in the source of the idea which controls the action. In suggestion, the idea comes from an external source—a picture, a story, a sound, the behavior of other people, etc. The clearest case of suggestion, however, is where the source of the idea is another person and where there is a definite intention on the part of that other person to produce a certain action in another. When an idea originates within ourselves we commonly speak of it as an impulse, an intention, but we do not call it suggestion. It can be readily seen from the above statements that no sharp line

² An interesting description and interpretation of such phenomena will be found in J. Jastrow, *Fact and Fable in Psychology* (Houghton Mifflin Co., New York, 1900).

can be drawn between actions resulting from normal volition and those resulting from suggestion. One writer has said that suggestion is no more a mystery than the fact that one can speak or write his thoughts, button his coat or sharpen his lead pencil at pleasure. What is meant is that in any case an idea leads to an action, the only difference being in the source of the idea.

Even this distinction has tended to break down in recent years with the introduction of the conception of autosuggestion. About the only characteristic of suggestion here retained is the *intention* to exert an influence over behavior. If one definitely attempts to influence his own behavior by keeping an idea in his mind, he is said to be practicing autosuggestion. Thus, Coué was said to have taught his patients autosuggestion by having them recite at frequent intervals some expression containing an idea which shall control their behavior. The idea originally introduced into the mind from without is kept there through the intention of the patient himself.

3. The third significant point in the definition of suggestion is that the idea which is to lead to action must be free from conflicting ideas. It is a well-known characteristic of the associative mechanisms that they are subject to inhibitions and interferences. Return for a moment to the illustration given above. Suppose that, shortly after eating dinner, I am seated in my chair as before, and that a certain bell rings. This time the sound of the bell does not lead to movements toward the dining-room. Ideas are present which conflict with the one which ordinarily follows the bell stimulus, namely, the knowledge that I have already eaten my dinner. It is said that even in the deepest state of hypnotism a subject cannot be made to commit murder, because it is impossible to remove entirely certain conflicting ideas which arise in the mind at such a time. In less extreme cases than this it is quite possible to eliminate con-

flitting ideas. In advertising copy, for example, it is often inadvisable to present arguments against competing brands of goods or even imitations because of the conflict that the presence of these ideas may create. It is far better to introduce directly into the reader's mind those ideas which shall lead to action, than to create a conflict in the hope that one's own commodity shall come out victorious.

THE LAWS OF SUGGESTION

Suggestion may be looked upon as a force to be guarded against or as a force to be employed. If one wishes to guarantee that his own behavior shall be as effective as possible, he will choose the former attitude; while if one happens to be especially interested in controlling the behavior of others, he will choose the latter attitude. Applied psychology should offer the material necessary for satisfying either demand. The so-called laws of suggestion which state the conditions under which suggestion may be most forcefully used, will, if thoroughly understood, serve both as an aid in the use of suggestion and as a protection against it. It is true, however, that most interest has been directed toward the former of these functions. For example, suggestion as a means of increasing the efficiency of the salesman has been widely exploited. No corresponding attention has been given to the protection of the potential purchaser against the influence of the salesman.

The laws of suggestion are concerned with the means by which one's ideas may be introduced into the mind of another and especially with the means of preventing active opposition to these ideas. If these two conditions can be complied with, the desired reaction will follow. The most important of these laws of suggestion follow:

1. The suggestion should be indirect, that is, it must seem to arise spontaneously within the mind of the individual, and not to come from another. Few persons are

willing to have their ideas and actions completely under the control of another person and will on that account alone often resist suggestions when made too directly. Suggestion is most effective when used to strengthen ideas already present, but which are prevented from leading to action on account of the presence of other conflicting ideas. In such cases the one idea may be strengthened sufficiently to lead to action without opposition. This is very much easier than implanting entirely new ideas. The following cases are good examples of indirect suggestion:

A stump orator mounts a log or a car and begins to harangue the crowd. In the grossest way he praises the great intelligence, the brave spirit of the people, the virtue of the citizens, glibly telling his audience that with such genius as they possess they must see clearly that the prosperity of the country depends on the politics he favors, on the party whose valiant champion he now is. His argument is absurd, his motive is contemptible, and still as a rule he carries the body of the crowd.

A huckster stations himself in the middle of the street, on some public square, or on a sidewalk, and begins to pour forth volumes of gibberish intended both as a compliment to the people and as praise of his ware. The curiosity of the passers-by is awakened. They stop. Soon our hero forms the center of a crowd that stupidly gazes at the "wonderful" objects held out to its view for admiration. A few moments more and the crowd begins to buy the things the huckster suggests as grand, beautiful and cheap.*

2. There must be a high degree of attention to the idea that is suggested. This is much the same as our earlier statement that there must be no conflicting ideas if a given idea is to lead to action. A high degree of attention to an idea may be obtained by the removal of distracting conditions of all sorts. This may be done by restricting bodily movements with the consequent reduction in the stream of

*B. Sidis, *The Psychology of Suggestion* (D. Appleton and Co., New York, 1911), p. 7.

sensations therefrom or by reducing the number of stimuli of the special senses, especially of vision and hearing. The conditions provided for inducing that extreme state of suggestibility known as hypnotism are for the purpose of concentrating and limiting the attention, as, for example, the darkened room, the crystal ball, the regularly beating metronome, the rhythmic stroking of the arm or head. One reason which has been offered for the great suggestibility of persons in a crowd is the restriction of bodily movement caused by the massing of the people.

3. The success of a suggestion depends upon its source. Prestige and authority are great factors in giving strength to a suggestion. The mere fact that some one in authority or one in whom we have great confidence does a thing is sufficient to give the suggestion of it great power. Thus, we are likely to follow the leaders in fashion, in politics, in all social manners and customs through the intensity of the indirect suggestions coming from these sources. A powerful factor in selling certain kinds of goods is the suggestion that the article is used by the President of the United States, by the King of England, that it is manufactured by the largest firm in the United States, or by the oldest firm, although none of these factors is in itself any real guarantee of the value of the commodity. In the suggestive power of prestige and reputation lies much of the power of great evangelists, great orators and entertainers. We find in them what we are led to expect to find. And the advertising campaigns are well calculated to develop our expectations, by implanting in our minds the most suggestive ideas.

4. The force of a suggestion depends in part upon the frequency with which it is applied. Repetition tends not only to increase the strength of the suggestion by driving out competing ideas, but tends also to make the suggestion seem spontaneous. In the course of the repetition, con-

sciousness of the external origin of the suggested idea is lost. Many a person has denied that he is influenced by advertising in the purchasing of foods and other necessities, and yet a canvass of these purchases shows that a large proportion of them are of the most widely advertised and trade-marked goods. It is very likely that advertising of the publicity sort met on every hand has much to do with the inability of people to account correctly for the disposition to buy certain brands of goods rather than others.

5. Positive suggestions are more effective than negative suggestions. It is more effective to say, "Do this," than it is to say, "Do not do that." Ideas tend more directly to the production than to the inhibition of action. In fact the only way to inhibit an action is to initiate the contrary reaction. There is a strong tendency to react to suggestion in the positive fashion no matter how it may be presented. This is well illustrated in the story many times repeated of the man who offered a large money prize to any person who could fry an egg and while doing so refrain from repeating to himself the word hippopotamus. No one ever succeeded in winning the prize for the negative suggestion guarantees the positive reaction. The relative value of positive and negative suggestion has been much discussed in connection with advertising appeals. The facts as here stated have sometimes been questioned because of the striking success of a few advertising campaigns based on the principle of negative suggestion. One cannot argue safely from a few cases especially where there are so many factors involved as in the success of advertisements. It is indeed very likely that if positive suggestions were presented as effectively as the negative suggestions have been the success of the campaigns would have been even greater than they were. Statistical studies have shown a striking decrease in the use of the negative appeal in advertising during recent years. The law of positive suggestion has never been overthrown.

INDIVIDUAL DIFFERENCES IN SUGGESTIBILITY

Numerous experiments have been devised for measuring suggestibility,⁴ and attention has been directed to the question of individual differences in this trait. One very definite conclusion has been reached, namely, that people cannot be classed into suggestible and non-suggestible groups. This trait is possessed in varying degrees just as intelligence is found to be distributed among the population. Furthermore, it has been found that a person who is very suggestible in one situation is not necessarily suggestible in another situation.⁵ It would seem that there are many suggestibilities rather than a single trait of suggestibility. As age increases it has been found that suggestibility tends to decrease. The exact relationship between intelligence and suggestibility is not known, but it is likely that there is at least a slight negative correlation between these two characters in the individual.⁶ As far as sex differences are concerned, no clear-cut differences between men and women have been discovered. Suggestion is a most powerful factor in those individuals who cannot or do not think for themselves. Waves of certain types of crime, waves of suicide by peculiar means, waves of kidnaping, waves of mania for dancing, waves of style, etc., are in part at least to be explained by the power of suggestion upon certain types of mind.

⁴Brief descriptions of such tests will be found in G. M. Whipple, *Manual of Mental and Physical Tests* (Warwick and York, Baltimore, 1914).

⁵W. Brown, *Individual and Sex Differences in Suggestibility*, University of California Publications in Psychology, Vol. II (1916), No. 6.

⁶A standardized test for suggestibility in children, together with data from a large number of subjects, will be found in M. Otis, "A Study of Suggestibility of Children," *Archives of Psychology* No. 70 (1924).

CROWD SUGGESTIBILITY

The suggestibility of people, when gathered into crowds, follows the same laws as that of the individual taken alone, but susceptibility to suggestion seems to increase in a crowd. There seems to be less resistance to suggested ideas, less repugnance toward being swayed by others. The conflicting ideas that help to determine the course of action in any one person taken alone are submerged in the group. Or, as one writer has aptly put it, "The intensity of personality is in inverse proportion to the number of aggregated men." Sidis⁷ thus describes the suggestibility of the crowd:

There is a gradual limitation of voluntary movement, a condition of monotony and inhibition with a consequent contraction of the field of consciousness. When a preacher, politician, the stump orator, the ringleader, the hero, gains the ear of the crowd, an ominous silence frequently characterized as awful sets in. The crowd is in a state of overstrained expectation; with suspended breath it watches the hero or the interesting, all-absorbing object. Disturbing impressions are excluded, put down, driven away by main force. So great is the silence induced in the fascinated crowd, that very frequently the buzzing of a fly or even the drop of a pin can be distinctly heard. All interfering impressions and ideas are inhibited.

By referring to the conditions of suggestibility previously mentioned it will be seen that here is an ideal setting for powerful suggestions to become effective. Often individuals are horrified at what they did as members of a mob. Religious revivals, political meetings, strike riots and lynchings are all illustrations of what individuals when collected into a large group, and under the influence of strong suggestion, will do.⁸

⁷ B. Sidis, *The Psychology of Suggestion* (D. Appleton and Co., New York, 1911), p. 300.

⁸ See W. McDougall, *The Group Mind* (G. P. Putnam's Sons, New York, 1920).

HYPNOTISM

Suggestion carried to an extreme degree is called hypnosis. It differs from normal suggestion only in this respect, and is a state in which the suggested ideas have absolute control. Hypnosis depends upon the same set of conditions as normal suggestion. There must be a restriction of voluntary movements, the avoidance of all sensory distractions, the inhibition of conflicting ideas. The view that the state of hypnosis may be induced in any person who will follow instructions perfectly is rather commonly accepted, although it is difficult to verify. Hysterical persons are especially subject to suggestive influences and form the most common material for demonstrations of hypnosis.

The phenomena of hypnosis in its spectacular form are more interesting than instructive for the applied psychologist, and the matter is mentioned in this chapter only as a variation from normal suggestibility.

A wider knowledge of suggestion and its conditions will do much to extend its application beyond the realm of entertainment and exploitation and make it a genuine force for increasing human satisfaction. No part of the human being's natural mental equipment offers greater possibilities for increasing his welfare. Without accepting any of the spectacular doctrines concerning the "power of mind over body," one may find sufficient sound evidence in the psychological laboratory for the prediction that it will play an increasingly important rôle in the development and control of human behavior.⁹

⁹ The use of suggestion in the diagnosis and treatment of disease is referred to in Chaps. XXVII and XXVIII.

CHAPTER VII

THE INFLUENCE OF AGE UPON EFFICIENCY

THE influence of age upon physical and mental capacity is universally recognized, and yet the popular conception of age qualifications of all sorts is neither definite nor uniform.¹ In practically no case is there good scientific foundation for the social, business and industrial age requirements. The economic factor may seem to be important in determining the age qualifications for work of various sorts. For instance, the labor of boys and girls is usually cheaper than that of adults, while the employment of old persons is not advisable because they are likely to be inefficient, and their employment may involve their care after they cease to be useful. There is, probably, also the expectation that certain physical qualities like strength, health and agility are more likely to be found within certain age limits, and that desirable mental traits such as speed of learning and adaptation are characteristic of certain ages. Perhaps, too, there is assumed to develop with chronological age a sense of responsibility and a kind of social sense.

A few examples will be given of age qualifications found in legal enactments and in occupational and educational requirements. The occupational age requirements were obtained from a survey of the "Help Wanted" columns of the Sunday edition of a large metropolitan newspaper. The

¹ For a survey of the stages of development in the individual, see H. L. Hollingworth, *Mental Growth and Decline* (D. Appleton and Co., New York, 1927).

list is in no sense complete and may be supplemented by the reader :

1. In some states no person under the age of 16 may drive an automobile, although the writer knows of no case where there is an upper or old age limit for such work.

2. The vote is limited to adults 21 years of age or older. Under that age men are infants in the eyes of the law, requiring a guardian for the transaction of legal business.

3. Persons under the age of 14 (sometimes 16) cannot be employed in industrial work.

4. Children under 5 years of age may ride free on most public carriers, and children under the age of 12 years may ride for half of the adult fare.

5. The so-called age of consent varies from 12 to 16 years in different states.

6. Applicants for police service must be over 18 years of age (sometimes 21).

7. Certain railroads will not employ men over the age of 35 years, and have a pension system whereby they are automatically retired from service at the age of 65-70 years.

8. The Constitution has established minimum age requirements as follows :

President	35 years
United States Senator	30 years
United States Representative	25 years

9. Advertisements for telegraph operators specify age limits of 16 to 26 years.

10. Advertisements for messengers specify age limits of 16 to 18 years.

11. Advertisements for office boys specify age limits of 14 to 18 years.

12. Requirements for clerks of different kinds vary between the extremes of 15 to 18 years and 30 to 35 years.

13. Minimum age requirements for public school children are: 6 years for entrance and 14 years for completion of school work.

14. Minimum age for entrance to college varies from 14 to 16 years.

When definite age requirements are not actually stated, applicants for positions are required to state their age, and the presumption is that it is a factor determining employment.

For many of these and other age qualifications there appears to be no sound reason. Why should the legal age be 21 years rather than 18 or 25 years; why should an intelligent 15-year-old boy be prohibited from driving an automobile, while a feeble man of 70 is not restrained? The whole conception of age requirements seems to be based upon the idea that chronological age is a real measure of physical and mental qualifications, or that there is a uniform change in individuals with age, so that number of years lived will serve as an index of fitness. The reliability of this age index of capacity must be determined by investigation, and the evidence thus far obtained tends to minimize its importance.

PHYSICAL AND PHYSIOLOGICAL CHANGES WITH AGE

The physical and physiological changes with age may be divided into two groups: First, those relatively rapid and pronounced changes, the date of whose occurrence is fairly uniform in all people, such as the appearance of the teeth, making possible a change from liquid to solid food, the maturing of the sexual mechanisms from 12 to 17 years of age, known as the adolescent period, and the menopause in women between the ages of 45 and 50 with its important physical and physiological changes. Second, there are the gradual and continuous changes in structure and function

which occur from the moment of birth to death, as enumerated in the following statements by Howell.²

The body increases rapidly after birth in size and weight. It is the popular idea that the rate of growth increases up to maturity and then declines as old age advances. As a matter of fact, careful examination of the facts shows that the rate of growth decreases from birth to old age, although not uniformly. At the pubertal period and at other times its downward tendency may be arrested for a time. But, speaking generally, the maximum rate of growth is reached some time during the intra-uterine period, and after birth the curve falls steadily. Senescence has begun to appear at the time we are born. . . . The signs of old age may be detected in other ways than by observations upon the rate of growth. Changes take place in the composition of the tissues; these changes, at first scarcely noticeable, become gradually more obvious as old age advances. The bones become more brittle from an increase in their inorganic salts, the cartilages become more rigid and calcareous, the crystalline lens gradually loses its elasticity, the muscles lose their vigor, the hairs their pigment, the nuclei of the nerve cells become smaller, and so on. In every way there is increasing evidence, as the years grow, that the metabolism of the living matter of the body becomes less and less perfect; the power of the protoplasm itself becomes more and more limited, and we may suppose, would eventually fail, bringing about what might be called a natural death. As a matter of fact, death of the organism usually results from the failure of some one of its many complex mechanisms, while the majority of the tissues are still able to maintain their existence if supplied with proper conditions of nourishment.

The special mechanisms which most commonly fail are the heart, blood vessels, the kidneys and the lungs. Now these changes are not so closely correlated with the number of years that one has lived that years may be taken as a sign of physical age; the failures are more likely to be due to accident or to manner of living than to age. Examples

²W. H. Howell, *Textbook of Physiology* (W. B. Saunders Co., Philadelphia, 1908), p. 904.

of this lack of correlation between physical condition and age in years are abundant. Many a man of 70 years is physically younger than others of 45. Realization of such disparity is leading to the development of new physical age standards. One's age may now be measured in such

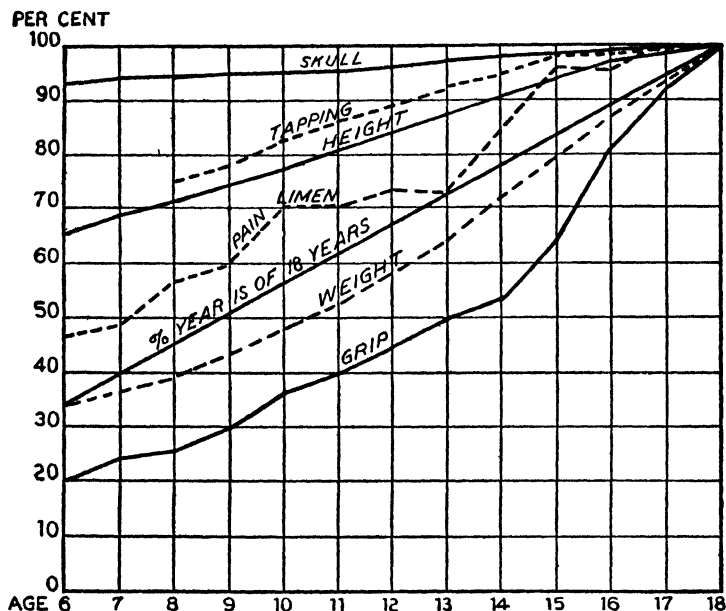


FIG. 2. RATE OF CHANGE IN PHYSICAL TRAITS WITH AGE

terms as blood pressure and kidney action, rather than in years, months and days. That "a man is as old as his arteries," has become a popular expression. A campaign for the utilization of old men as office helpers, clerks and messengers to offset the scarcity of labor, would be quite justifiable if coupled with the physical examination of all candidates and the selection of those chronologically old but physically young.

Careful measurements emphasize not only the great in-

dividual variations in physical and physiological development with age, but also the variation in the rate of development of different characteristics in the same individual. The curves in Figure 2 indicate the different rates of change in a few physical characters, height, weight, length of skull, strength of grip, speed of movement (rate of tapping with finger) and sensitivity to pain. In order to make the data comparable, all age values for the different measurements are expressed in terms of the value at 18 years of age, which is taken to represent 100. Measurements of this sort have not been systematically made beyond the age of 18 years. The figures along the base line show the chronological age, and those along the vertical show the per cents of the 18 year values. Differences in the shape of the curves will indicate differences in rate of development. For instance, the length of the skull changes only slightly but very uniformly from 6 to 18 years. Strength of grip, on the contrary, undergoes considerable change, with an increase in rate at the age of 14 years, the adolescent period. Between these extremes various rates of change appear. Each curve may be compared with the straight line which represents the change in age upon the basis of 18 years as 100.

TABLE VI. AVERAGES OF PHYSICAL TRAITS AT THE AGE OF EIGHTEEN

<i>Trait</i>	<i>Unit of Measure</i>	<i>Average Value</i>
Height	Centimeter	165.0
Weight	Kilogram	57.0
Skull Length	Millimeter	189.0
Strength of Grip	Kilogram	39.5
Tapping Rate	30 seconds	195.0
Pain Threshold	Kilogram	1.9

Table VI gives the 18-year values for each of the traits as well as the units of measure for each. In the first column

of the table are listed the traits; in the second is given the unit in terms of which the measurement was made; in the third appears the record for 18-year-old boys and girls, the values representing the average of the records for the two sexes.

The figures just quoted are based upon different groups of children at each age. There is, therefore, a chance of error due to the possible change in the composition of the groups at different ages. A few recent studies of mental and physical growth *in the same persons* over a period of years have contributed much additional knowledge of the changes which take place from birth to maturity. Curves of physical growth have been constructed from measurements of the same individuals repeated at half-year intervals. On the basis of such curves it is possible to predict, within a certain error, what the physical character, such as height and weight, will be at the age of 16 years, if the height and weight at the age of 6 are known. A series of such growth curves for height, over a period of 10 years, is shown in Figure 3.³

Concerning these curves the author says: "In the 1914 bulletin it was discovered that the increase of growth in height is comparatively uniform for each individual, so that the growth curves enable one to prophesy with a high degree of accuracy how tall a child of normal growth will be in the subsequent age, providing his or her relation to a given median or norm is known. In brief, tall children do not become short; neither do short children, as a rule, become tall under normal conditions. This discovery has been verified again with these new data."

The study of the individual differences in physical and physiological characteristics shows that heredity is a very

³ B. T. Baldwin, *The Physical Growth of Children from Birth to Maturity*, University of Iowa Studies in Child Welfare, Vol. I (1921), No. 1.

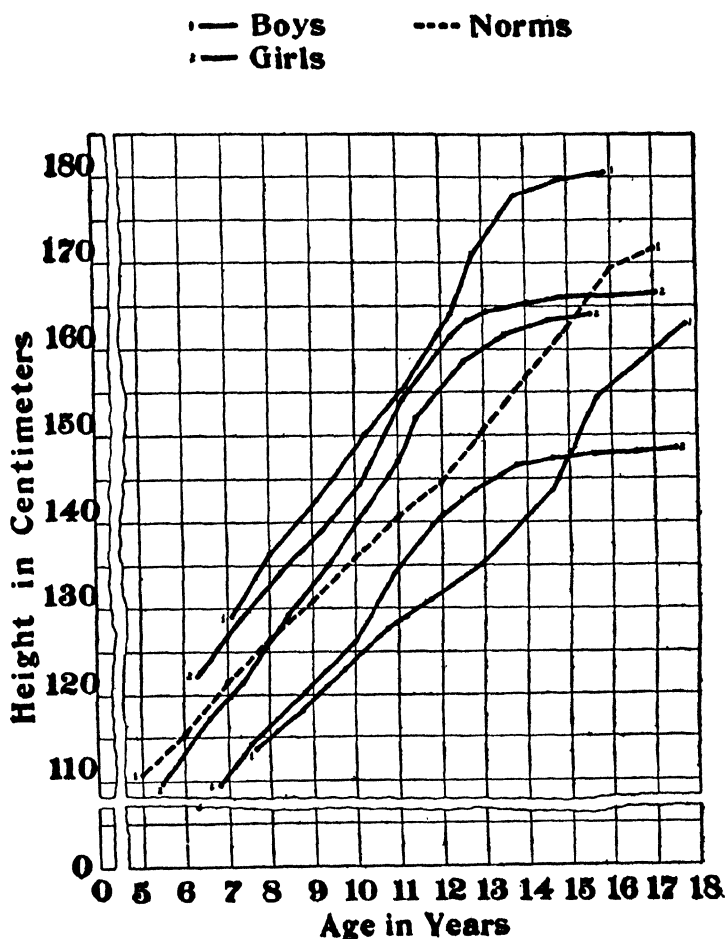


FIG. 3. INDIVIDUAL GROWTH CURVES IN HEIGHT

potent factor in the years up to maturity. Beyond that period, environmental influences and special habits of living have considerable influence in determining the bodily condition. Hence the struggle to keep physically young with

increasing years, if properly conducted, will have its reward within limits.

MENTAL CHANGES WITH AGE

Mental functions, like physical structures and physiological functions, undergo rapid changes at certain periods. The mental is correlated with the physical to the extent that the two periods of most profound mental change are adolescence in boys and girls and the menopause in women. The adolescent period has been the object of much study, because the time of its occurrence makes of it an educational problem. Then there is the gradual mental development with age. The intelligence tests of the psychological laboratory have disclosed interesting relations between age and mental development, both in the nature of differences among individuals and in variations in different functions within the same individual. It has been found, for instance, that instead of all the mental functions developing at the same rate, there is great variation, even in such functions as rote memory and logical memory. The laboratory tests have been limited largely to persons of school age, since for educational purposes mental growth during this period is of most interest.

Figure 4 will give some indication of the relative rate of change of a few mental functions. In order to make the data of the different mental traits comparable, they have been treated in the same manner as the physical traits described earlier, that is, the records for age 18 have been taken as the standard and the other ages are represented in terms of per cent of this 18-year record. Examination of the chart shows that logical memory reaches a maximum at 13 years of age with no change up to 18 years, while rote memory (measured by memory span) shows a more gradual increase with its maximum about 17 years. Certain of the traits, e. g., word building, indicate an increasing

rate of improvement from 6 to 18 years, while others, e. g., association, show a decreasing rate of improvement. The straight line represents the age change in terms of 18 years as 100, or the standard. To determine the rate of change of a trait, its curve should be compared with this age curve.

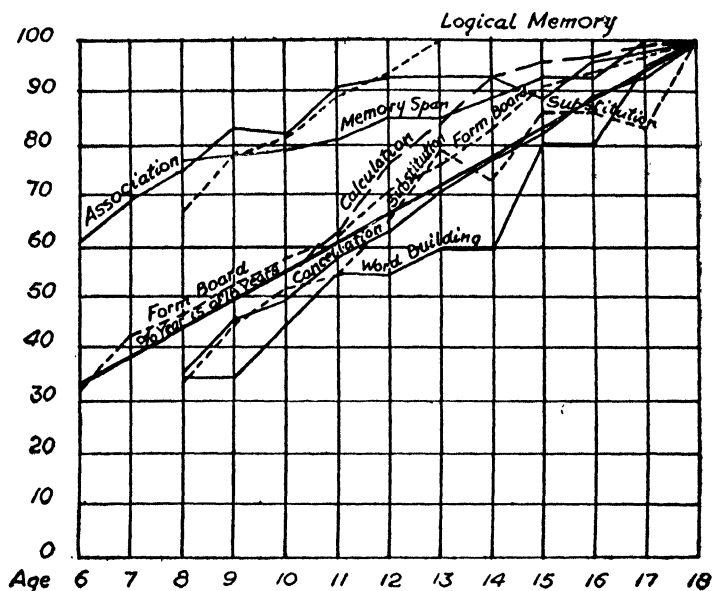


FIG. 4. MENTAL GROWTH CURVES

The values for the different traits at the age of 18 are given in Table VII, together with the unit of measure for each trait. Each figure represents the average record for boys and girls. From these figures and by reference to the curves, the values for each age may be determined.

There is even greater disparity between age in years and mental growth than between the former and physical growth. If one is physically in his prime at 25 years of age, he may reach his mental zenith at 60 years or older.

TABLE VII. AVERAGES OF MENTAL TRAITS AT THE AGE OF EIGHTEEN

<i>Trait</i>	<i>Unit of Measure</i>	<i>Average Value</i>
Memory Span (Digits)	Items	8.6
Logical Memory	Items	37.5
Substitution	Items	29.5
Cancellation	One Minute	22.5
Word Building	Five Minutes	19.5
Associations (Common)	Per Cent	90.0
Form Board	Seconds	10.0
Calculation	One Minute	58.0

A great deal of emphasis has been given to the disparity between age in years and mental development by the mental tests of Binet-Simon and others, and the term "intelligence quotient" has been coined to express the relation between them. From these tests one can assign to an individual a mental age in years by comparing his performance with the so-called age norms. Thus, if a 16-year-old boy makes a record in the tests such as the average 10-year-old boy makes, his mental age is 10. The intelligence quotient is this mental age divided by the chronological age. A quotient of 1.00 would then indicate a person mentally normal, or one as much developed as the average person of his age, a quotient of .75 would indicate one below the average and a quotient of 1.25 would indicate a person above the average intelligence for his age. "It is by no means uncommon to find 7-year-olds who can do intellectual work at which one in twenty 17-year-olds would fail." And it is still less uncommon to find a 25-year-old person with the mental age of a boy of 12. Obviously then, for most practical purposes it is mental age rather than chronological age which is important. The age scales for the determination of mental ability were originally devised for the detection of mental deficiency in children, and more recently have

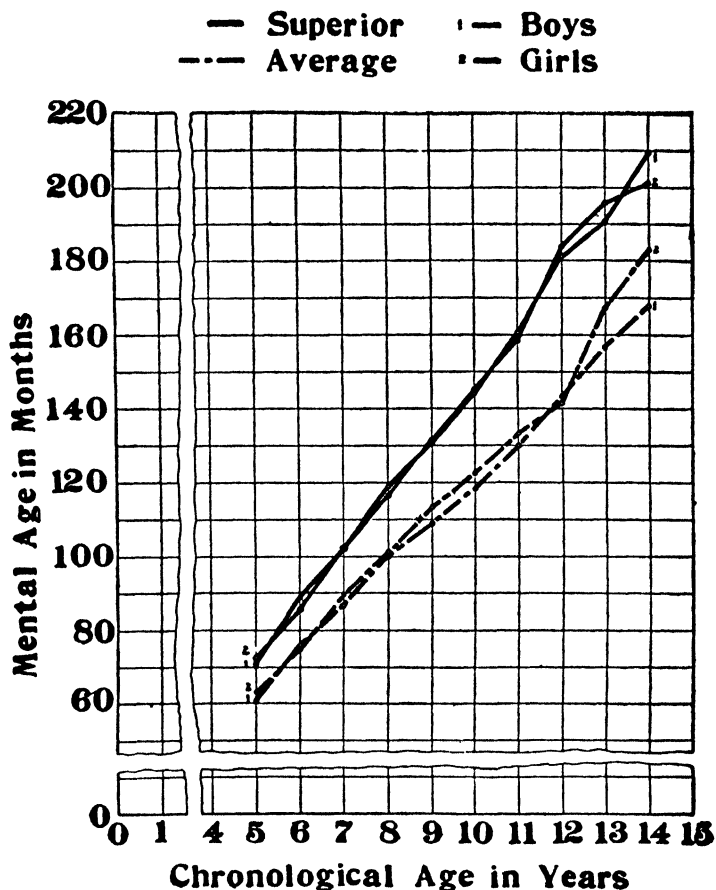


FIG. 5. MENTAL GROWTH CURVES OF SUPERIOR AND AVERAGE CHILDREN

been modified to cover ages above twelve years. It may in time be possible to measure the intelligence of any adult of any nationality in terms of an intelligence scale.

Curves for growth in mental capacity are being developed in the same fashion as those for physical traits. At present the curves do not cover a sufficiently long period of years,

but it will not be long before the mature intelligence of a person can be predicted at an early age, with a known degree of accuracy. Curves of growth for average and superior children are illustrated in Figure 5.⁴ The curves are very similar in general form to the physical growth curves. The mentally superior children develop on a different level from average children and they tend to grow increasingly dissimilar with increase in chronological age.

The intelligence quotient expressing the relationship between mental and chronological age for a given individual is now generally conceded to be fairly constant. A certain amount of fluctuation in the I. Q. is to be expected because of the many variable factors that enter into its determination. But allowing for this error, which may be expected to be no greater than 5 points, a child who at the age of 6 years has an I. Q. of 1.30 will at maturity have an intelligence equally far above the average. It is impossible to estimate the value of the ability to predict a child's mature intellectual capacity at such an early stage of his career. His educational and vocational development may, a few generations from now, be guided from its beginning so as to make most effective use of latent capacities.

OTHER MEASURES OF DEVELOPMENT

In addition to chronological age and mental age, attention is being directed toward an anatomical age and a physiological age, varying more or less independently of the first two ages. An effort is being made to measure anatomical age in terms of the development of the wrist bones as determined from X-ray photographs;⁵ and physiological age is

⁴B. T. Baldwin and L. I. Stecher, *Mental Growth Curves of Normal and Superior Children*, University of Iowa Studies in Child Welfare, Vol. II (1922), No. 1.

⁵See Prescott, D. A., *The Determination of Anatomical Age in School Children and its Relation to Mental Development*, Studies

inferred from certain signs of sexual development. There seems to be good evidence that, for children of a given chronological age, and of a normal physical development, there may be a difference in physiological age of from one to 4 or 5 years. It is quite likely that, just as chronological age, at one time the indicator of development, has been supplemented by mental age, so this latter will need to be further supplemented by anatomical and physiological indicators. The profile of specific growth rates will supplant that of any one taken alone.

In addition to these age changes in intellectual capacities, emotional, attitudinal and volitional changes must also occur. But the backwardness of the scientific study of these aspects of personality makes it impossible to say to what degree these changes depend on age rather than on experience and circumstance. Moreover, because of the complexity of the facts it is not easy briefly to summarize even the nature of the direction of these changes.⁶

CHANGES WITH AGE IN ADULTS

Very few measurements have been made to show with any precision the nature and rate of the changes in mental ability beyond the age of adolescence. Nevertheless, the study of mental changes in maturity and senescence has many practical aspects, and psychology should speedily afford exact determinations in the place of the desultory observations now offered.

in *Educational Psychology and Educational Measurement* (1923), Series 1, No. 5, Harvard University; also B. T. Baldwin, *The Physical Growth of Children from Birth to Maturity*, University of Iowa Studies in Child Welfare, Vol. I (1921), No. 1, Chaps. 7 and 8.

⁶For experimental studies of social maturity or "social age" see Gates, G. S., "An Experimental Study of the Growth of Social Perception," *Journal of Educational Psychology*, Vol. XIV (1923), pp. 449 f.

The problems of the continuation school and the night school as adjuncts to the public school system, of the workers' education movements, and of adult education generally, which are beginning to attract the attention that they deserve, all depend for their satisfactory solution upon a knowledge of abilities and interests which adults can be expected to possess. Recognition should be given to the processes of deterioration in old age, which makes expedient the determination of the point where the burdens of responsibility should be reduced or cease altogether.⁷ Exact measurement can be applied for the fixing of maximum age limits as well as minimum age limits for mental and physical activities.

Theoretically, growing old might have one of three possible effects on a given mental capacity. The capacity might continue to improve, or it might remain unchanged, or it might deteriorate. Or the observable change or lack of change in a given ability might be the result of two opposed tendencies.

One investigation is on record in which groups of adults, ranging in age from 18 to 45 years, were measured in five mental tests. The scores for different age groups are given in Table VIII. Each age group record represents the average of about 100 people. The tests used are indicated at the left of the table. The Completion test requires that missing words in sentences be supplied in order to make them meaningful. The Opposites test requires that words be named which have meanings opposite to those presented. The Word Building test measures facility in constructing words from a given series of letters. The Digit test measures the memory span for numbers. The Substitution test involves the translation of simple material by means of a set of symbols. This is the one test which most definitely involves

⁷ G. S. Hall, *Senescence* (D. Appleton and Co., New York, 1922).

TABLE VIII. MENTAL CHANGES WITH AGE

	<i>Age Level</i>				
	Below 20	20-25	25-30	30-35	35-40
Completion	31	32	32	32	34
Opposites	12	12	11	12	12
Word Building	10	10	9	10	12
Digits	6	5.5	6	6	6
Substitution	68	64	60	58	57

ability to learn new connections or to establish new associations, and it is the only one of the five which shows a decrease in efficiency with age. The relatively early appearance of this decline suggests what is perhaps the first intellectual sign of the approach of old age. The age at which the acquisition of new facts and intellectual expansion ceases is at present largely a matter of speculation. The fiftieth year is frequently stated as the end of the period of mental growth.

CHAPTER VIII

THE INFLUENCE OF SEX UPON EFFICIENCY

THERE is one other inherited characteristic that must be considered in a study of efficiency, namely, sex. It is inherited from our immediate ancestry, although the factors which determine sex are not yet understood. To what extent does one's sex predetermine efficiency in practical life? Does being a male or a female imply the possession of certain original characters which make one or the other incapable of certain kinds of useful activity? This is an extremely difficult question to answer, on account of the characteristics which the sexes might readily acquire from their early training, and on account of the fixed traditions which have been cultivated concerning the proper occupations for men and women. Certainly, custom has been a very powerful factor in determining what shall be the sphere of the sexes. Just because the sexes are never subject to the same environmental conditions, there is scarcely any opportunity to study their differences in original nature.

Much confusion in the popular discussions of sex differences arises from the fact that the exact meaning of the term "sex differences" is seldom specified. It may mean, first, the differences between the sexes as they exist to-day, regardless of their cause—education, tradition, more general environmental factors or heredity—and it may mean, second, *natural* differences only. These two meanings should be recognized and kept distinct. The first interpretation is the more immediately practical, while the second is the more theoretical. From the practical point of view the material

must be dealt with as it is. Can women, constituted and developed as they now are, do as well and without harm the work generally done by men? This practical question of the relative power of the sexes was answered to a certain extent in the warring countries because the scarcity of men forced women into many of the positions formerly occupied exclusively by men. In the course of a few years one grew accustomed to hearing of women iron workers, women street-car conductors, motor women, women farmers and women chauffeurs. And they seemed to be efficient in these tasks. What the effect of this work will be, in the course of time, upon women and their progeny remains to be discovered. Interesting statistics are available concerning the efficiency of women in industry. In a work published by the Russell Sage Foundation¹ in the interest of labor legislation, it is stated that women suffer especially from present-day conditions in industrial work, such as overstrain from its excessive speed and complexity, prolonged standing and the absence of a monthly day of rest.

In addition to their susceptibility to injuries of the generative organs, working women have been found more liable than men to disease in general. There is a consensus of opinion among those who have longest observed girls and women at work, that the burdens of industrial life press more heavily upon them than upon men. Wherever statistics of the morbidity of both working men and working women exist, the morbidity of women is found to be higher. . . . The two most important facts to be noted are women's higher morbidity when compared with men in the same occupations, and their longer duration of illness, measured by the number of days lost from work. . . . Thus are women physiologically handicapped by a greater general liability to disease, and a peculiar susceptibility to injuries of the generative organs. In a word, they are less resistant to fatigue than men, and their organisms suffer more gravely than men's from the strains and stresses of industrial life.

¹ J. Goldmark, *Fatigue and Efficiency* (Russell Sage Foundation, New York, 1912).

A statistical study of the eminent women of history and their relation to various environmental forces leads to the following observations concerning the performance and the opportunities of contemporary women:²

In the old world it is probable that woman will always be able to acquire fame with the wedding ring, and to reign as a sovereign, thus being assured a place in history. If we eliminate those two groups, the fields in which contemporary women are acquiring eminence are, in spite of greater social and educational advantages and freedom from restriction in many lines, limited to three. Fifty-five women or 51.4 per cent of the group are writers; twenty or 18.7 per cent are musicians; fourteen are actresses. We wish that we might not have found Jane Addams working alone in the great field of social reform, and that Madame Curie might not have been the only scientist of her generation. In America, where women enjoy greater freedom and opportunity than in any other part of the globe, there is little evidence of any special results of these advantages. The generation and nation are proud of the achievements of Helen Keller, but it might be expected that our great educational institutions would produce feminine scholars and teachers of great ability. Possibly, they are in our midst, but like the prophets of old, are without honor in their own generation as well as their own country.

Such facts as these may well be questioned when presented as evidence of natural sex differences. In the case of working women, there is often the burden of looking after the home in addition to the industrial labors, which is not borne by the men. In short, not only similarity of industrial conditions must be taken into account, but all other differences in the environment outside of working hours must likewise be considered. Even in the case of the more favored classes of women where opportunity seems to invite the rise to eminence, powerful social traditions must

² C. S. Castle, "A Statistical Study of Eminent Women," *Archives of Psychology* No. 27 (1913).

be reckoned with. The limitation of the fields in which eminence is attained by contemporary women is in itself as likely to be indicative of such influences as it is to be indicative of the character of native endowments.

When interest shifts to the question of the ultimate future efficiency of the sexes, it is vital to know whether there are natural differences in capacity such that the finished product will always be different, or whether the differences that are noted are subject to eradication through the processes of training and the regulation of the environment. It is the matter of these natural differences that has attracted the greatest scientific interest. It will be evident that, except in the rare cases where measurements can be made upon newborn or extremely young infants, and in the case of those functions which develop independently of environmental influences, if there be such, and in the cases where the effects of such influences can be discounted, the native sex differences will have to be inferred rather than directly observed. The present status of the intelligence tests as a measure of one form of native capacity shows that the task of detecting native sex differences is not entirely hopeless.

PHYSICAL AND PHYSIOLOGICAL DIFFERENCES

The question of sex differences can best be handled by considering, first, the physical and the physiological and then the mental characteristics of the sexes. Physically, women have a smaller average size and weight of the body as a whole, and of parts such as the skull and trunk. Men are uniformly stronger than women and more so than the difference in bodily size and weight would warrant. The difference is to be attributed at least partly to intrinsically stronger muscles, rather than to differences in their development. The most striking difference in structure and functions, however, is in what are called the primary sex char-

acters.³ Thus the anatomy and the physiological mechanisms of women are adapted to the bearing and the rearing of children, whether they ever have them or not. In connection with this primary sex function, all females have been thought to be handicapped by their periodical functions, which incapacitate them both physically and mentally for a certain time each month, and on this account women have been considered as excluded from many of the professions and occupations open to men. The same argument has many times been used against coeducation. A certain amount of physical disability may be granted. But careful experimental study⁴ of mental and motor ability over long periods of time has failed to show any rhythmic variation in ability or performance, and has tended to refute the older views as inapplicable to normal healthy women.

INTELLECTUAL DIFFERENCES

Are there any innate mental qualities peculiar to each of the sexes? Perhaps the most important differences to be looked for would be those of the so-called instinctive equipment. Can any differences in instinctive equipment be discovered? There are two instances mentioned by Thorndike,⁵ namely, differences in the pugnacity or fighting instinct and in the parental instinct. The former is said to be much more prominent in men and the latter in women. If such native differences really exist they will account for much of the difference between the sexes, e.g., the great prominence of men in the field of competitive activities and of women in the moral qualities resulting from her natural

³For a survey of data of this nature, see H. Ellis, *Man and Woman* (Charles Scribner's Sons, New York, 1914).

⁴L. S. Hollingworth, "Functional Periodicity," Teachers College, Columbia University, *Contributions to Education* No. 69 (1914).

⁵E. L. Thorndike, *Educational Psychology*, Vol. III (1914), Chap. 9, Teachers College, Columbia University, New York.

tendency toward parental activities. It is no simple matter to decide upon the relative strength of these two instinctive tendencies in men and women, because as general concepts the meaning of the terms is not definitely determined. And further, the environmental differences may be such as to give prominence to the different tendencies in the two sexes very early in life, although they may be originally equal in strength. There is little agreement among authorities concerning any other instincts in which the sexes might differ.

Are there any natural differences between the sexes in general intelligence? This question may be answered by studying the records of tests of mental characteristics little affected by training. Thorndike has collected the most important data concerning sex differences in mental ability. These are given in Table IX. The figures represent, in the case of each trait, how many males are as good as or better than half of the females (or what per cent of the males reach or exceed the median of the females). For instance, in the case of the tests for spelling the table shows that only thirty-three per cent of the men attain a degree of efficiency attained by fifty per cent of the women. In all cases the records are the result of laboratory tests, except where they are noted as derived from school marks.

These records are collected from various sources and represent different degrees of reliability. The twenty traits may be roughly divided into three groups, namely, those traits in which women excel (1 to 7); those traits in which the sexes are equal (8 to 14); and those traits in which men excel (15 to 20). An examination of these three groups may give some grounds for belief in certain differences generally attributed to the sexes. For instance, women appear to be better in language work, and men in science work, women rank higher in sensitivity and men in activity. But the overlapping of the sexes in these traits is just as sig-

TABLE IX. SEX DIFFERENCES IN INTELLECTUAL FUNCTIONS

<i>Name of Test</i>	<i>Per Cent Men Reaching Median of Women</i>
1. Color Naming and Card Sorting	24
2. Cancellation Tests	33
3. Spelling	33
4. English (School Marks)	35
5. Foreign Languages (School Marks)	40
6. Immediate Memory	42
7. Sensory Threshold	43
8. Retentiveness	47
9. Association (Speed and Accuracy)	48
10. General Information	50
11. Mathematics (School Marks)	50
12. School Marks (Average of All Studies)..	50
13. Discrimination (Other than Color)	51
14. Range of Sensitivity	52
15. History (School Marks)	55
16. Ingenuity (Special Tests)	63
17. Accuracy of Movement (Of Arm)	66
18. Physics and Chemistry (School Marks)..	68
19. Reaction Time	70
20. Speed of Movement (Finger and Arm)...	71

nificant as the differences. And, further, one cannot exclude the possibility that these differences, such as they are, may have other than a hereditary basis.

A great mass of material^{*} has accumulated from the widespread use of the intelligence tests in schools and colleges, and from it sex differences may be computed. In children of various ages up to and including the fourteenth year, the females exceed the males by a few points of I. Q. (Intelligence Quotient). This is paralleled by the

^{*} See L. M. Terman, *The Measurement of Intelligence* (Houghton Mifflin Co., New York, 1916), pp. 68 ff., also "Genetic Studies of Genius" (Stanford University Press, 1925); and C. Burt, *Mental and Scholastic Tests* (London County Council, London, 1921).

increased rate at which female children mature physiologically. This difference, however, disappears entirely when the two sexes reach adult age. Hence it has no particular significance as far as the life achievement of the sexes is concerned. Terman, in his study of about 1,500 gifted children (minimum I. Q. 132), found a larger proportion of boys than of girls in the group, the lowest ratio being 120 boys to 100 girls. A careful examination of his methods of selecting the gifted children failed to reveal any bias working in favor of the boys, either in the original nomination of the cases or in their examination by the Stanford-Binet test. The ratio is, therefore, accepted by him as a genuine picture of the sex differences among highly gifted children. No entirely satisfactory explanation of the facts is offered.

SEX DIFFERENCES IN VARIABILITY

There are still other possibilities of differences between the sexes. One of these is a difference of variability within the two groups, which, if found to be the case, would be a very vital difference. For instance, if men were found to be the more variable sex, in the sense that men covered a greater range of performance, then the best and the worst human beings would be men, and the fact that men have figured more prominently in the deeds of the world would be accounted for in the original constitution of the sexes. Likewise, if this were true, the highest achievement in the future could be expected from men.

A rather common opinion among scientific men has been that men *are* more variable than women in this sense. The view was first contested by Karl Pearson⁷ and since that time the earlier studies have been examined more critically and much evidence has accumulated which casts doubt on claims of differences in variability between the sexes. When

⁷ K. Pearson, *The Chances of Death* (Arnold, London, 1897).

unfavorable environmental conditions are allowed for, and sufficiently large numbers of individuals are tested, differences in variability do not appear. Three sorts of evidence have been presented in an attempt to dispose of the problem of sex variability:

1. Physical measurements of newborn infants of both sexes. This is perhaps the only case where innate variability of the sexes can be compared, unmodified by environmental influences, since by the time that mental tests can be given the latter factor may have changed the innate tendencies. Hollingworth and Montague⁸ studied careful physical measurements of 2,000 newborn babies, 1,000 of each sex, and failed to find any significant differences in the range of variability in the two groups in the characters measured. Pearson studied physical characteristics of adults of both sexes and he too failed to find any differences in variability.

2. Mental tests of the two sexes. The most recent studies of large groups of people of the two sexes fail to show any differences in variability in the abilities tested. Among such studies may be mentioned that of Trabue on 13,000 school children in the completion of sentences, the arithmetic tests of Courtis on several thousand children, the Binet-Simon tests made by Terman on 1,000 children and Pyle's extensive measurements of school children.

3. Statistical studies⁹ of mental deficiency in the two sexes. Such studies made by institutions for the feeble-minded and defective show at first glance that there are more men than women admitted to these institutions. Since this is just what should be expected if men were more

⁸L. S. Hollingworth and H. Montague, "Comparative Variability of the Sexes at Birth," *American Journal of Sociology*, Vol. XIX (1914), pp. 510 ff.

⁹L. S. Hollingworth, "The Frequency of Amentia as Related to Sex," *Medical Record*, October 25, 1913.

variable than women—men being both better and worse than women—the data have been used in support of the contention that men are more variable than women. But a closer study of the significance of the figures, together with consideration of the forces that bring cases to institutions for the defective, shows that the two sexes are affected unequally by these forces. Defective women are much more likely to be maintained outside of institutions than men, because they are essentially a dependent and non-competitive class, hence do not succumb in the economic struggle. As far as range of variability of the two sexes is concerned, the above arguments give no good grounds for assuming a difference.

NON-INTELLECTUAL DIFFERENCES

Men and women may be said to differ in ways not measured by these mental tests, for instance, in emotionality, impulsiveness and sympathy. Although these characteristics cannot be measured in the same way as some of the simpler mental qualities, still they may be investigated in less direct ways. Some results have been reported which are based upon the judgments of the two sexes by friends, teachers, relatives and acquaintances. Such measures of characteristics based on this type of judgment conscientiously made are subject to inaccuracies, but still give a more reliable picture of sex differences than the casual impressions or prejudices that usually form the basis of opinion. Thorndike has worked over all the available records of this sort and has presented them so as to show the per cent of men reaching or exceeding fifty per cent of the women in each trait. For instance, in the case of patience, thirty-eight per cent of the men are found to have the degree of patience found in fifty per cent of the women. The traits studied and their values are given in Table X.

In practically all of these characteristics, as in the groups

of traits previously described, there is a great overlapping of the two sexes. It is quite likely also that some of the differences which are shown may be due to the different standards in the traits which custom decrees for men and women, that is, the differences may be due to environmental rather than to hereditary factors.

TABLE X. SEX DIFFERENCES IN NON-INTELLECTUAL TRAITS

<i>Name of Trait</i>	<i>Per Cent Men Reaching Median of Women</i>
1. Interest in Persons Rather than Things..	15
2. Emotionality	30
3. Temperance	30
4. Impulsiveness	34
5. Religiousness	36
6. Sympathy	38
7. Patience	38
8. Vanity	40
9. Shyness	42
10. Temper	56
11. Self-Consciousness	57
12. Humor	61
13. Independence	70

It is possible that research into the functions of the internal secretory organs and their relation to personality traits may reveal sex differences that have not yet been measured, and that will account in part for the popular notion of the ways in which the sexes differ. It is already known that the complex endocrine mechanisms are intimately bound up with the development, activity and decline of the sex functions. The primary sexual characters may be correlated with glandular activities which at the same time may make the sexes differ in such mental manifestations as emotion, temperament, etc.¹⁰

¹⁰ For a popular account of such data, see L. Berman, *Glands Regulating Personality* (The Macmillan Co., New York, 1921).

OTHER POSSIBLE SEX DIFFERENCES

Among the possible sex differences for which the glandular mechanism would be responsible are energy differences. As Leuba¹¹ has pointed out, "no adequate test of the dynamic aspect of the mind—that is, of interest, persistency, energy—has as yet been devised. When it is realized that the intellectual abilities are useless without motive power, the impossibility of deducing from the possession of equal intellectual abilities equal life achievements becomes obvious. Little may be expected of a person finely gifted intellectually, if he be not also well endowed with mental energy. The talents of the artist, without the power of ceaseless work, are of little avail."

Given two individuals of the same intellectual capacity but differing in the quantity of work they can perform, the one with the greater energy will have the greater achievements to his credit. For instance, if in college seven hours of work is required for meeting the scholastic requirements, and if one individual is exhausted by seven hours of work while another can do nine hours of work, the latter will surpass the former in both curricular and extra-curricular activities. He is likely, moreover, to give the impression of greater intellectual ability. The same is true in life generally. Leuba offers some evidence for such energy differences between the sexes, in the facts of muscular strength and fatigue, and especially in the functions of the endocrine glands, and among these the thyroid, the thymus and the pituitary glands. These views are suggestive and should initiate further inquiry. They are offered here only as evidence for the statement that the problem of the equality or the inequality of the sexes has not been completely solved.

From the strictly practical point of view and in the light

¹¹ J. H. Leuba, "The Weaker Sex: A Scientific Ramble," *The Atlantic Monthly*, April, 1926, pp. 454 ff.

of present established facts, the matter is aptly summarized in the following statement of Thorndike.¹²

The most important characteristic of these differences is their small amount. The individual differences within one sex so enormously outweigh the differences between the sexes in these intellectual and semi-intellectual traits that for practical purposes the sex differences may be disregarded. So far as ability goes, there could hardly be a stupider way to get two groups, alike within each group but differing between the groups, than to take the two sexes. As is well known, the experiments of the past generation in educating women have shown their equal competence in school work of elementary, secondary and collegiate grade. The present generation's experience is showing the same fact for professional education and business service. The psychologist's measurements lead to the conclusion that this equality of achievement comes from an equality of natural gifts, not from an overstraining of the lesser talents of women.

¹² E. L. Thorndike, *Educational Psychology, Briefer Course* (Teachers College, Columbia University, 1915), pp. 345 f.

CHAPTER IX

WORK, FATIGUE, REST AND SLEEP

WE have had occasion to speak of the importance of fatigue in connection with earlier topics. Among other things we have found that fatigability is given as one important difference between the sexes; and that the quality of one's learning at any time depends upon the influence of fatigue; that it is more economical to divide time available for learning into a number of periods in order to avoid fatigue, rather than spend it in continuous study. And we shall find one of the most vital questions in all practical work to be how to eliminate, avoid or recover from fatigue. The answer to these questions and many others requires that we shall understand the phenomena of fatigue, both physical and mental, and especially that we shall be able to detect the real symptoms of fatigue.

WHAT IS FATIGUE?

In spite of the multitude of studies of fatigue that have been published during the last fifty years, there is a great diversity of opinion as to how the term shall be defined. Only in the mind of the uninitiated layman is the matter free from doubt. He knows what fatigue is and regulates his behavior so as to avoid it or recover from it when it cannot be avoided. He knows that fatigue is "being tired," and that when tired the proper thing to do is to rest. Such a meaning is satisfactory and safe except where the question of making the most of oneself is forced to attention. Then doubts begin to arise, because sometimes one feels tired when

he has done no work at all, and sometimes he does not feel tired after a long period of work. He discovers, too, that the tired feeling occasionally disappears in the course of work instead of becoming more pronounced as it should.

Most of the definitions of fatigue that have been proposed have embodied these common-sense notions, although emphasizing one or another aspect of them. One rather widely accepted definition is that fatigue is the reduction in the output of work as the result of work, and which is recoverable by rest. In this case the feelings of tiredness are not mentioned, but they are nevertheless potent factors in determining output of work. Thus Woodworth¹ says: "Everyone who has worked with the ergograph has certainly felt these sensations. Everyone recognizes that their tendency is to check contractions. Everyone must have noticed the difficulty, amounting in untrained subjects to impossibility, of resisting this tendency. Yet few have recognized the sensations of fatigue as an actual factor in the determination of the rate of fatigue."

The lack of correlation between changes in output of work and changes in the feelings, especially where some strong incentive or spur to activity is present, leads to difficulty in the formulation of an adequate definition of fatigue. The following case will illustrate the nature of the discrepancy.² Twelve subjects worked continuously for approximately five and one-half hours at the task of inserting words into incomplete sentences so as to give them their proper meaning. The work was divided into 15 units. Between the fourteenth and the fifteenth units a rest of ten minutes was introduced. At the beginning of the experiment and at the end of each unit of work, the subjects rated the quality of their feelings on a scale of seven degrees, ranging from "Extremely good" to "Extremely tired." The average out-

¹ R. S. Woodworth, *Le Mouvement* (O. Doin, Paris, 1903).

² A. T. Poffenberger (*unpublished*).

put curve and the average feeling curve for all the subjects are reproduced in Figure 6. The left-hand scale is in terms of per cent of the maximum score possible, and the right-hand scale is in terms of the seven grades of feeling. The various units of work and the rest interval are shown along the bottom of the chart. The output is seen to remain about the same throughout the whole five and one-half hours.

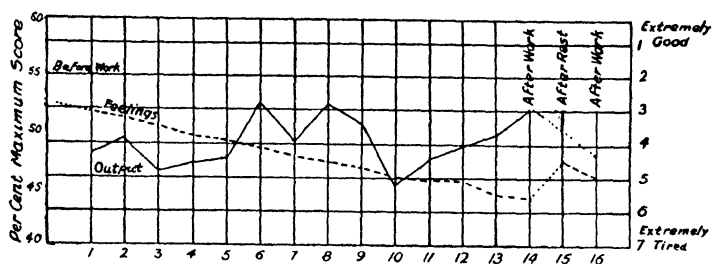


FIG. 6. RELATION BETWEEN FEELINGS AND OUTPUT

Every subject was well acquainted with the nature of the test and had a preliminary trial so that practice effect is probably negligible. The feeling curve fell steadily until the ten-minute rest was introduced, when it recovered somewhat. It dropped again during the last unit of work following the rest. Observations made by the experimenter in the course of the work disclosed increasing weariness, irritability, restlessness, outbreaks of profanity and threats of refusal by some of the subjects to continue the work. The influence of the group (all the subjects worked together in one large room) and the high rate of pay constituted sufficiently strong incentives to prevent any actual desertions.* When such spurs to activity as these are absent, as in ordinary industrial work, there is a much closer relationship be-

* For another experiment yielding similar results, see E. L. Thorndike, "The Curve of Work and the Curve of Satisfyingness," *Journal of Applied Psychology*, Vol. I (1917), pp. 265 f.

tween changes in output and changes in the quality of the feelings.

Muscio,⁴ after making a critical examination of these and other difficulties inherent in the various interpretations of fatigue, recommended that the concept of fatigue be banished from precise scientific discussion, and that in its stead attempts should be made to measure the effects of different amounts of work directly upon mental and physiological functions without the intermediary notion of fatigue. That is, measurements should be made to determine the effects of activity and not the presence or absence of fatigue. The practical problem would then be to reduce the amount of psychophysical work required per unit of production. Although the recommendation of Muscio implies merely a shift of emphasis, it is a healthful one in that it forces attention upon the mechanism of work and the changes which it undergoes while functioning. When the changes are known and ready means of measuring their amount discovered, the practical problem of efficient work will be easy of solution. The relative extent of the changes during different work conditions will show which are the most favorable conditions for work.

CHANGES IN THE PSYCHOPHYSIOLOGICAL MECHANISM DURING WORK

Certain characteristics of the human mechanism at work are well known. First, activity requires the consumption of energy-producing material, very much as the production of work in the steam engine requires the burning of coal. If the supply of energy-producing material were to be entirely consumed, further work would be impossible until a new stock of material had been provided. This energy-

⁴B. Muscio, "Is a Fatigue Test Possible?" *British Journal of Psychology*, Vol. XII (1921), pp. 31 f.

producing substance in the muscle is glycogen, a chemical substance created in the liver and in the muscles, from material taken from the blood stream. Energy is set free when the oxygen of the blood unites with this glycogen in the muscle. In strenuous muscular activity the glycogen is used more rapidly than it can be supplied and, consequently, the supply is depleted. A lack of this fuel would occur rather rapidly, if the supply were limited to what is present in the muscle or even in the blood, and if it were not for the fact that the liver serves as a storehouse for glycogen and throws off into the blood stream a quantity sufficient to keep the muscles supplied in the course of ordinary muscular activity. But in cases of extreme and prolonged muscular work even this reserve of energy-producing material may be exhausted and further activity become impossible.

Second, complete exhaustion of glycogen, except under extreme conditions, does not occur because activity is stopped from another cause before that danger point is reached. The consumption of energy-producing material leaves certain by-products, among them being carbon-dioxide and lactic acid, which act as poisons to the tissues, and when permitted to accumulate in sufficient quantities, may clog the muscle and retard or inhibit its action. Under ordinary circumstances these waste products are eliminated about as rapidly as they are produced through the activity of the kidneys, sweat glands, etc., but under prolonged activity they accumulate faster than they can be removed. The presence of these poisons, rather than the actual exhaustion of combustible material, is in most cases responsible for the changes resulting from work. These poisons do not remain in the active muscle, but are washed into the blood stream. When carried by the blood in great quantities they may affect the inactive portions of the musculature and the body as a whole.

Third, the mechanisms involved in work tend to maintain a state of equilibrium or balance between the processes of waste and repair. This involves the circulation of the blood and the lymph as the carriers, breathing as the means of supplying oxygen and as an aid in eliminating waste products, the kidneys and the secretory mechanisms of the skin, the nervous system as the means of communicating changes in balance in various parts of the body, the activity of the liver in contributing energy material to the blood stream, and the glands, especially the adrenal glands, as emergency mechanisms which can speed up the functions of all the others. As the blood is the primary medium of exchange in these processes, an analysis of it shows some interesting phenomena of work. When active muscular work is just beginning, the blood shows a disturbance of equilibrium, a depletion of oxygen supply and an increase in carbon dioxide content. This is soon followed by a change in the opposite direction when the collaborating mechanisms adjust their activity to the new needs of the body, so that the blood shows an excess of oxygen and a diminution of carbon dioxide. An over-compensation has taken place in the reaction toward maintaining a balance among the various processes. Thus shortly after work begins, efficiency may actually increase, giving what is known as the "warming up" effect. This overcompensation gradually disappears, and the normal constitution of the blood is held for a period. If the work continues long enough or is very strenuous, the blood analysis shows that the balance is again disturbed and an increase of waste over repair is indicated. In terms of production, a decrease in output occurs, and in terms of feelings the worker becomes tired. If the excess of waste products increases, activity will finally cease. A period of rest, taking food, etc., will restore the proper balance.⁵

⁵For an interesting series of experiments upon animals in which such facts are demonstrated, see G. B. Hastings, "The Physiology of

Increasing knowledge of the functions of the internal secretory organs in regulating metabolism is shedding light upon some of the great mysteries of human achievement. The capacity for meeting emergencies by sudden spurts of power, for greatly prolonged work as a result of incentives, and for overcoming apparent exhaustion in times of great excitement, that have made our conceptions of fatigue seem unreal, is closely associated with the function of the adrenal glands. For instance, the substance secreted by these glands, among other reactions, stimulates the liver directly to discharge its reserves of energy-producing material into the blood, stimulates the breathing to provide the blood with more oxygen, increases the rate at which the blood travels, and at the same time stimulates the kidneys to draw off from the blood stream the by-products of work. Such facts as these have been demonstrated in physiological experiments.* It is not difficult to see the biological significance of such an emergency device as a factor in survival. Thus, we have in the extremely complicated reactions of one set of glands, which have been stated here in the most schematic fashion, the means of accounting for feats of great strength, apparent recovery from exhaustion and surprising endurance in terms of supply and demand for energy-producing material, and the creation and elimination of the by-products of energy liberation. The fact must not be lost sight of that these are in the nature of emergency reactions and that under unusual stimulation the customary safeguards against exhaustion are removed and that the dangers of overwork become greatly increased. In the use of incentives one should know whether he is arousing merely a normal response of the worker, or whether he is calling forth these emergency reactions.

Fatigue: Physico-Chemical Manifestations of Fatigue in the Blood," U. S. Public Health Service, Public Health Bulletin 17, 1921.

*W. B. Cannon, *Bodily Changes in Pain, Hunger, Fear and Rage* (D. Appleton and Co., New York, 1915).

RELATION BETWEEN WORK AND REST

Experiments have not been made to determine the rate at which the constitution of the blood changes at different stages of continuous work, although such a study would give valuable information concerning the efficiency of work. The studies of work curves in terms of output that are available suggest that the work process becomes more inefficient the

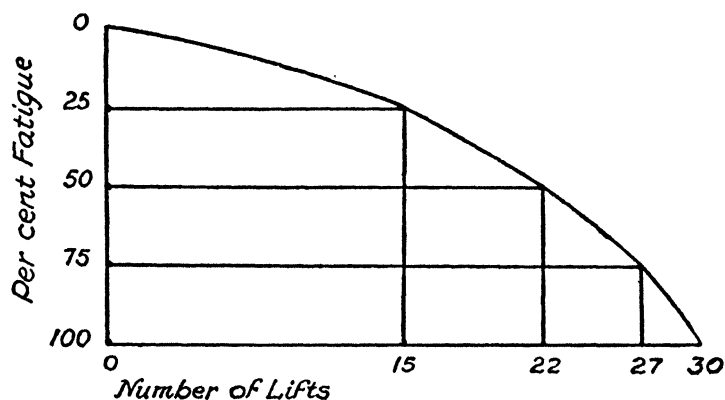


FIG. 7. RATE OF FATIGUE DURING WORK

more the rate of waste exceeds the rate of repair. The same conclusion is reached from a study of the rate of recovery from the effects of work during rest. Mosso in one of his early ergograph experiments found that, with a given load to be lifted, the finger became exhausted after lifting the weight thirty times. Complete recovery from this work required two hours of rest. When the work was stopped after the weight had been lifted only fifteen times, complete recovery was attained in only a half hour. Thus the recovery time is reduced to one-fourth by reducing the number of lifts one-half. From these simple facts a hypothetical recovery curve can be constructed as shown in Figure 7. The

horizontal scale indicates the number of lifts, while the vertical scale indicates the per cent of the time required to recover from complete exhaustion, zero being at the top of the scale and 100 per cent at the bottom of the scale. It appears then that it took three times as long to recover from the second half of the work (the second 15 lifts of the weight) as from the first half (the first 15 lifts of the weight). It appears also that the last three lifts cost as much in time re-

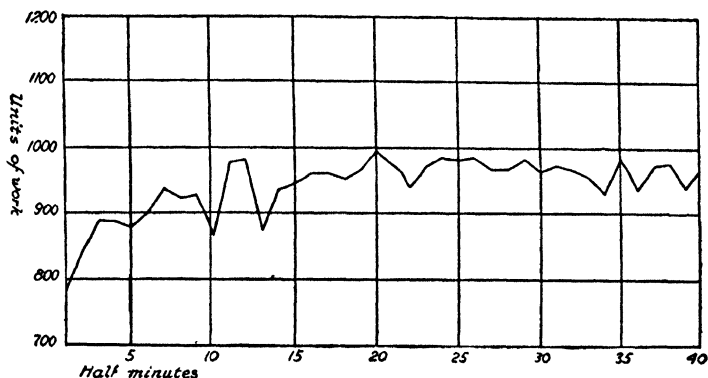


FIG. 8. WARMING-UP PHENOMENON

quired for recovery as the first fifteen lifts. If now recovery time be thought of as related to degree of disturbance of metabolic equilibrium as we have described it, then carrying work to the limit of exhaustion would be uneconomical because the last few units of work would be too costly. On the other hand, the introduction of a half hour of rest would always keep the worker in that part of his curve where the cost per lift would be the least. The problem of efficient work reduces, therefore, to keeping the worker in the efficient part of his curve through the introduction of rest, adjustment of load, etc.

There is no reason to believe that all disturbance of the balance of metabolism through work is harmful. To re-

turn to the recovery curve again, it is possible that rest should be introduced at the end of the fifteenth lift rather than at the end of the fifth or the tenth. It is certainly not true that the most desirable work schedule would be the one in which the resting time was the greatest in relation to the working time. The exact point at which work should cease depends upon a multitude of circumstances, in addition to the character of the work. One of the most important of these factors is the rate of adaptation to the task, or what has just been called "warming up," which is the name given to the increasing output at the beginning of the work period. It is clearly indicated in Figure 8,⁷ which is the work curve for a very simple task where the influence of practice has been eliminated. The vertical scale shows the units of work done, and the horizontal scale shows the consecutive half-minute divisions of the work period. The maximum output of work was not reached until the end of about sixteen half-minute units. The work begins to decrease in quantity at about the twenty-sixth half-minute. It would seem, therefore, that any work period shorter than eight minutes would lose some of the improvement due to adaptation and would therefore be uneconomical. The work schedule that is most efficient is the one that has work periods long enough to make the most of the adaptation process, with rest periods just long enough to recover from fatigue, but not so long as to cause loss of the adaptation.

Such a schedule has been prepared for the work of folding handkerchiefs. Each hour of the working day is divided into six-minute periods, and for each five minutes of work there is one minute of rest. Although one-sixth of the day is spent in rest, the more intense work possible during the other five-sixths results in about three times as much work from each employee. Schedules for other sorts of

⁷E. S. Robinson and W. T. Heron, "The Warming-Up Effect," *Journal of Experimental Psychology*, Vol. VII (1924), pp. 81 f.

work have been prepared with equal increase in efficiency. Some of them show very clearly that the optimum relation between work and rest, at least as far as output is concerned, lies somewhere between very long and very short rests in relation to working time. Data of this sort are presented in Chapter XIX.

LOCAL AND GENERAL EFFECTS OF FATIGUE

It should be evident from the nature of the changes in metabolism that occur during work that the effects of work are both local and general. There is a partial depletion of the combustion materials and an accumulation of the by-products of combustion in the working part. At the same time, through the medium of the circulation of the blood and lymph and through neural communication, supplies are brought to the seat of activity, and the removal of waste is accelerated. Since the supplies are drawn from other parts of the body and since the waste products are carried in the blood stream, local changes in metabolism are reflected in the body as a whole. But all these adjustment processes take a certain minimum time, so that the local effects of activity are always more pronounced than the general effects. Then, too, these local changes would entail relatively slight modifications of other mechanisms because of the wide distribution of the effects. Strenuous activity of one part of the body, such as the arm, may be followed by pain and other acute symptoms in the arm, and by a general lassitude or weariness of the organism as a whole. We are now in a position to answer a question which is frequently asked, namely: Is a change of occupation a rest? Since the effects of work are more pronounced in the working part than elsewhere, a change of occupation would bring into action mechanisms that were more ready for economical service. Allowance must be made, of course, for the necessity of

getting adapted to the new occupation. The value of occasional shifts of occupation in industrial work is demonstrated in the data presented on page 226.

When the second task is easier than the first, that is, requires the consumption of less energy, it will give rest or relief when compared with the effects of a continuation of the original work. It would be better to say that there is in such a case a relative reduction in the amount of energy consumed. Usually the changes of occupation which one makes when tired are toward the easier and more pleasurable tasks. One's own inclination seems to take care of that, so that the common impression is likely to be that changes of occupation are a distinct rest.

INDIVIDUAL DIFFERENCES IN CAPACITY FOR CONTINUOUS WORK

It is natural that people should differ markedly in their capacity for continued work, since the work process is found to involve so many of the bodily functions, each of which varies in efficiency from individual to individual. The range of individual differences is as great in respect to work as in any other where measurements are available. Some persons seem able to maintain a work schedule that would be impossible for others. At the other extreme are the individuals who become exhausted after taking a few steps and who figure so prominently in the case histories of psychopathology. Figure 9 presents the work curves of four men who lifted a 24-pound weight every two seconds by bending the arm at the elbow, each one continuing the work as long as he could. The vertical scale shows kilogrammeters of work done at each lift, and the horizontal scale indicates the number of separate lifts. Although the four began at about the same level of performance the best one did more than twice as much work as the others. All the men were in

good health and had some previous training in the work. Strength, undoubtedly, is an important factor in such a performance as this, yet many other factors, some of them mental, play an important part.

In comparing the efficiency of individuals it is well to remember that there is useless as well as useful work, and



FIG. 9. INDIVIDUAL DIFFERENCES IN RATE OF FATIGUE

that some persons do much more useless work per unit of useful work than others. As far as energy is concerned, the useless work is just as costly as the useful. The person who worries, or is otherwise emotionally upset, who works under high tension, who fidgets or keeps his whole musculature under strain while at work expends his energy needlessly. In selecting persons for a given type of work, therefore, it is not enough to determine the soundness and strength of the working parts, but it is necessary also to know something about their habits of work.

CHANGES IN THE PSYCHOPHYSIOLOGICAL MECHANISM DURING
MENTAL WORK

Does mental work entail the same kind of energy expenditure as occurs in muscular activity? ⁸ Needless to say this question is an involved one, since mental activity is paralleled by neural activity, and nearly always, if not always, by muscular activity. For instance, "mental multiplication," or the multiplication of numbers without visual or written aids, comes near to being purely mental work; and yet the extreme state of attention necessary for such work is accompanied by sense organ adjustment and tension of much of the bodily musculature. Consequently, "mental work" may be responsible for loss of energy-producing material and for the accumulation of the by-products of combustion through its necessary components of muscular and neural activity. The metabolic changes in muscular activity have been sufficiently discussed. The expenditure of energy in neural activity has been questioned by some authorities and by all others is considered slight in amount compared to muscular activity. Histological examination of nerve tissues gives evidence of change after prolonged work, especially in the cell bodies. Evidence has been obtained also which indicates the presence of combustion products in the nerve fibers. It is reasonable to suppose that there would be an expenditure of energy in nerve activity, though the amount may be small and the rate of recovery rapid. If this be true, there would be the possibility of nervous exhaustion as well as muscular exhaustion in extreme cases. Reduced readiness of neural mechanisms to act is quite possible as the result of the transfer of the so-called fatigue

⁸ For a detailed consideration of the theories of mental work and fatigue, see E. L. Thorndike, *Educational Psychology*, Vol. III (1914), Chap. 5; and R. Dodge, "The Laws of Relative Fatigue," *Psychological Review*, Vol. XXIV (1917), pp. 89 f.

products from the muscles by way of the blood to the nerve tissues, and is generally recognized as the cause of the mental lassitude following upon severe and prolonged muscular work.

There are several reasons why the noticeable effects of mental work should be slight compared with those of strictly physical work. First, the complement of muscular activity in the former case is very much less than in the latter. And there is some reason to believe that the fatigue effects of mental work are in proportion to the amount of muscular work it involves. Second, mental work is not local in the sense that muscular work frequently is. The forms of mental activity that have been studied, such as "mental multiplication," are highly varied and involve many neural connections in sequence. Recent studies that have been made of the mental work curve suggest that continued exercise of a single neural mechanism will rapidly induce exhaustion, and that the curve would have much the same shape as the physical work curve. Such circumscribed mental activity is, however, highly artificial and difficult to arrange even in the laboratory, so that one does not encounter it in everyday life. Perhaps the nearest approach to it is in the highly specialized operations of industry requiring a high degree of attention with practically no muscular exertion.

The effects of mental work ought, then, to manifest themselves in general symptoms such as lassitude, weariness and sleepiness, rather than in local discomforts and inability to react. Finally, it must be remembered that not all disturbances of functional equilibrium are necessarily harmful. But there seems to be no doubt that long-continued and intense mental work will be followed by the same symptoms as strenuous and prolonged physical work. Mental work may be made more efficient by the same means that will improve physical work. Attention should be di-

rected to such factors as posture, adjustment to working conditions, removal of distractions, the correct program of work and rest, and above all, the elimination of all forms of useless activity that so readily associate themselves with useful work. Mental work is especially likely to develop numerous useless accessory reactions, due to excitement, worry, emulation, fear and nervousness. It may happen that any one of these reactions will cause more loss of efficiency than all the useful work that is done. The only remedy for such inefficiency is to be found in the establishment of good habits of work. Mental work deserves at least as much analysis to this end as physical work.

METHODS OF MEASURING ECONOMY OF WORK

The shift of interest from the concept of fatigue to the psychophysiological changes resulting from work leads to the search for means of measuring these changes. The most direct method, namely, examining the modifications in the constitution of the blood during work, which has been employed in the study of animals, cannot of course be adapted to the study of human work problems. But some less direct indicator of changes in rate of general metabolism is quite feasible. The technique of the calorimeter chamber⁹ has been used in laboratory studies for measuring all the products of metabolism of the human body. It gives the best possible measure of the cost of human work, but the method is too complicated for general use. Consequently attempts have been made to find certain products or reactions which shall serve as samples of the whole process of metabolism and which shall be closely enough correlated with it for purposes of practical measurement.

⁹ F. G. Benedict and T. M. Carpenter, *The Influence of Muscular and Mental Work on Metabolism* (U. S. Dept. of Agriculture, 1909).

THE MEASUREMENT OF RESPIRATORY CHANGES

The amount of oxygen absorbed in the lungs and the amount of carbon dioxide given off in breathing have been used as indices of metabolism. Modern forms of the respiration calorimeter¹⁰ make such measurements possible under a wide variety of circumstances. For instance, it has been used to determine the relative cost to industrial workers of different methods of carrying loads.¹¹ The measures were sensitive enough to distinguish not only between different methods of carrying but also between different loads carried in the same manner. It has been used also for measuring the energy expended by children in school. This method will, doubtless, have a wider application in the measurement of the efficiency of work methods, both mental and physical, in business, industry, school work and in everyday life. At present the technique is rather difficult and the sources of error hard to control, so that its widespread use is not advisable. Other respiratory tests such as the vital capacity, length of time the breath can be held, and the force with which the air can be expelled from the lungs, have been tried as fatigue tests but thus far have not given promising results.

THE MEASUREMENT OF CIRCULATORY CHANGES

As the circulatory system is extremely sensitive to local changes in metabolism and as the part it plays in maintaining metabolic equilibrium is well known, many attempts have

¹⁰ A description of this device will be found in Benedict, F. G., "A Portable Respiration Apparatus for Clinical Use," *Boston Medical and Surgical Journal*, Vol. CLXXVIII (1918), pp. 667 ff.

¹¹ E. M. Bedale, "Comparison of the Energy Expenditure of a Woman Carrying Different Loads in Eight Different Positions" (Industrial Fatigue Research Board, London, 1924), Report No. 29. E. M. Bedale, "Energy Expenditure and Food Requirements of Children at School," *Proceedings of the Royal Society*, London (1923), B 94, pp. 368 f.

been made to find in changes in the circulation during work a satisfactory indicator of its cost in energy. Those who have worked most extensively with these measures¹² consider it an established fact that pulse rate is proportionate to metabolism—with certain restrictions as to blood pressure—in the course of either physical or mental work, and that in relative pulse rate there is a real psychodynamic measure. The difficulties in the practical application of this method are obvious. The amount of pulse change with work is a purely individual matter and constitutes an important characteristic of the human organism. Furthermore, changes occur in this respect with modifications in health, in amount of physical training, and with changes in environmental conditions, and time of day. What appears to be the most serious obstacle to the practical use of this measure is its apparent sensitiveness to non-significant activities. An emotional disturbance will cause more violent distortion of the pulse curve than much hard work. We have to do here with the distinction between useful and useless work. The cost of useful work, in terms of energy expenditure, is dependent in part upon the amount of useless work that accompanies it. Therefore all the fluctuations in the pulse during work *may* come to have significance. Where such factors can be controlled and made equivalent, two different kinds of work giving rise to the same pulse rate may be regarded as probable physiological equivalents.

The use of other circulatory changes as indicators of metabolic changes resulting from daily work have been disappointing. An extensive survey¹³ of a number of such measures has been recently made in the measurement of the

¹² See R. Dodge, "Mental Work: A Study in Psychodynamics," *Psychological Review*, Vol. XX (1913), pp. 1 ff.

¹³ F. S. Lee and J. D. Van Buskirk, "An Examination of Certain Proposed Tests for Fatigue," *American Journal of Physiology*, Vol. LXIII (1923), pp. 185 f.

effects of a fourteen-mile walk. Among the data taken were the heart rate, sitting and standing; the increase in rate on passing from one position to the other; blood pressure, systolic and diastolic; pulse pressure, and the vascular skin reaction. Tests were made before and after the exercise and the records compared. An hour always intervened between the exercise and the tests. The investigators concluded that they had found no reliable criterion of daily physical fatigue in any of the phenomena studied. They mention, especially, the influence of the psychic factor in the distortion of the cardiovascular records.

MEASUREMENT OF STRENGTH

It is conceivable that the state of metabolism of the body would have an appreciable effect upon performance in strength tests. Consequently such tests have been proposed as indicators of the metabolic changes accompanying different kinds of work. The most promising appears to be the Martin Strength Test,¹⁴ which measures the amount of traction that certain muscle groups can resist. The test has been used primarily for determining standards of strength required for certain kinds of industrial work. But its author says, "Variations of strength between the beginning and the end of the working period, particularly if they take the direction of a falling off at the end of the shift, are indicative of an impairment of physique which can be most readily explained on the basis of fatigue." Table XI gives a few sample figures showing per cent of change in strength as the result of a day's work of different sorts. There are two kinds of work, heavy and light, represented in the table, as well as two groups of workers, strong and weak, as measured by the strength tests. Plus signs mean increase

¹⁴ E. G. Martin, *Strength Tests in Industry*, U. S. Public Health Service, Public Health Report No. 606.

TABLE XI. CHANGES IN STRENGTH DURING WORK

Operation	PER CENT CHANGE	
	Strong	Weak
Heavy—Swaging valves	0.00	— 4.60
Brazing heavy parts	+ 1.00	— 6.00
Light—Milling machine	+ 3.20	+ 0.68
Drilling and burring	+ 5.00	+ 1.60

in strength and minus signs mean decrease in strength. The table shows that heavy work causes a greater percentage of loss in strength than light work, and also that strong individuals suffer less than weak ones. It will be noticed that the strong group of workers increased their strength in one of the heavy tasks and in both of the light tasks, and that the weak group increased their strength in both the light tasks. There has been an inclination to doubt the value of a test for measuring physiological changes during work which shows an actual improvement after the "expenditure of much energy." Muscio¹⁵ criticizes the test because of the errors to which it is liable when administered under factory conditions and by different testers.

MEASUREMENT OF SENSORY EFFICIENCY

A number of sensory acuity tests have been proposed as indicators of metabolic changes resulting from work. Many years ago the sensitivity of the skin as indicated by the two-point threshold was supposed to show the fatiguing effects of a day spent in school. Much more recently the visual acuity test has been employed for the same purpose. Like-

¹⁵ B. Muscio, *The Measurement of Physical Strength with Reference to Vocational Guidance* (Industrial Fatigue Research Board, London, 1922), No. 16.

wise changes in the sensitivity of the skin to electrical stimulation have been suggested as indicators of fatigue. The criticism made against the earlier as well as the most recent use of such tests is that the functions are subject to such great variations due to momentary fluctuations in attention that more gradual changes from work are likely to be completely overshadowed. It is possible that a modification in the technique of the visual acuity test may make it more serviceable for this purpose. As will be shown in Chapter XI, a form of this test has been used for measuring decreased efficiency of the visual mechanism resulting from continuous work. Instead of the momentary acuity test which is commonly used, the capacity to maintain a high degree of acuity for a period of three minutes is measured. The acuity test in this form might be of service in detecting general lowered efficiency. The trouble with a momentary test where the function is to any extent under voluntary control is that temporary spurts of power are possible even in an advanced state of fatigue.

MEASUREMENT OF ATTENTION CONTROL

It has been pointed out by numerous investigators that work involving a high degree of attention is likely to be more fatiguing than that which demands merely strength or speed. There are other reasons for believing, too, that attention is a highly sensitive barometer of general mental and physical efficiency. Interesting results have been obtained from the application of such a test as one measuring the ability to control the rate at which reversals of perspective occur in looking at simple drawings of cubes, etc.¹⁶ Difficulties have been encountered in the practical administration of the test, as it requires not only a skilled operator but well-trained sub-

¹⁶ I. E. Ash, "Fatigue and Its Effects upon Control," *Archives of Psychology*, No. 31 (1914).

jects in order to get satisfactory results. The success of its use in the laboratory makes it worth while to examine further into its possibilities as a fatigue measure.

MEASUREMENT OF ACCESSORY REACTIONS

On the assumption that any muscular response involves metabolic changes, that form of work will be the least efficient which has the greatest number of accessory movements attached to it. Morgan,¹⁷ in attempting to discover the effect of distractions upon efficiency, found that useful work under distractions was accompanied by a variety of non-productive responses. From this he inferred that, although the output of work did not decrease under distraction, the work was less economically performed. The same method might be employed in measuring the efficiency of work generally where the difficulty of the work consists primarily in overcoming distractions. The mere presence of useless movements would be a crude measure at best, unless some expression of their intensity could be obtained. The work of Morgan shows that quantitative measures are feasible.

MEASUREMENT IN TERMS OF RECOVERY TIME

Any considerable disturbance in metabolism requires time for recovery, hence it is possible that efficiency of various work methods could be measured in terms of the time required to recover fully from a period of work. The method has never been used in practice and is at present being tried out under laboratory conditions. It is, however, not a method that could be used readily outside the laboratory because it requires a careful control of all the conditions of work. The experiment of Mosso, mentioned in the early

¹⁷ This experimental study is discussed at length in Chapter XIX. J. J. B. Morgan, "The Overcoming of Distraction and Other Resistances," *Archives of Psychology*, No. 35 (1916).

part of this chapter, may be referred to here. It was shown in his ergograph study that the longer the work continued, the greater was the time required for recovery, and also that the last tenth of the work was as costly in recovery time as the first half of the work. If the recovery measure is found to be sufficiently sensitive in laboratory studies to measure small changes in work conditions, conclusions may be reached under controlled conditions that will have considerable practical significance.¹⁸

MEASUREMENT OF THE FEELINGS

Enough has been said already concerning the feelings as indicators of the capacity to work. Under ordinary working conditions, the feelings will not be disregarded and, when unpleasant, will undoubtedly influence the output. For this reason alone, it is safe to conclude that the most effective working conditions are those which, other things being equal, give the greatest satisfaction. It is not definitely known to what extent one may safely ignore these feelings of weariness and pain that accompany long-continued activity. Their biological function would seem to be to act as safeguards against overexertion. The meaning of the subjective symptoms, however, differs considerably from person to person, so that about all that can be said at present is that one who wishes to approach his maximum efficiency should neither take his feelings too seriously nor disregard them entirely, but do some conscientious experimenting until their import for himself can be discovered.

MEASUREMENT OF OUTPUT

From the practical point of view, the final measure of efficiency will probably continue to be the quantity and quality

¹⁸ S. L. Crawley, "An Experimental Investigation of Recovery from Work," *Archives of Psychology*, No. 85 (1926).

of work produced in a given unit of time. If a man is shoveling dirt and the amount shoveled per hour at the end of the day is only two-thirds of that shoveled in the early part of the day, he has lost about one-third of his capacity. And if some modified form of work method shows a loss of only one-sixth, under otherwise similar conditions, the latter is the better method. Still, to one who has followed the discussions in this chapter, the danger of such a measure of efficiency is obvious. For a loss of one-sixth the amount of production in a day's work instead of one-third may entail such a drain upon the stamina of the worker that over a period of one or three or six months the apparently better method of work would really be the poorer.

This survey of the methods available for detecting the psychophysiological results of work shows that the problem is a difficult one, indeed, and has met only a partial solution. It seems safe to conclude that the more directly a method measures the changes in metabolism, the better it is likely to be, as such a measure will be freer from the distortion of results that comes from the voluntary adjustments of a person during a test, the fluctuations of attention, etc. It has been suggested that each individual must work out for himself and from his own experience what his limits of safety are, and the rule has been offered that the safe limit for fatigue is that degree of it which can be recovered from in one normal night's sleep. Such criteria each one probably does work out for himself, but the great shortcoming is that many persons who are never forced to do real intensive work do not discover their maximum efficiency, and consequently live on a much more inefficient plane than necessary. The rule would apply only where a person is trying to find his limit of normal fatigue.

Measurement in terms of output or production in which each person learns to interpret certain conscious signs as indicative of his safe limit is, then, about the only rule that

can be laid down, in our present inability to measure the physiological changes without difficult and elaborate procedure. In industrial work where certain uniform demands are made, the personal differences must be taken into account, e.g., that some persons tire quickly, others slowly, that some work at high pressure for a short time, others work more slowly and steadily, and a standard must be set which will approximate a fair maximum for the majority of people working at a given task. The establishment of performance standards for various kinds of work is one of the most important problems which efficiency engineers are attempting to solve.

RECOVERY FROM THE EFFECTS OF WORK THROUGH SLEEP

Recovery from the effects of work would be most rapid during a period of complete inactivity. Such a state, however, can only be approximated, but never attained, since our minds are active during all our waking hours, and many of our muscles are active, even if in no other way than in supporting part of the body weight. Consequently, all rest might be conceived as a change of occupation in which the second activity approaches more or less a state of complete inactivity. Even during sleep there is not perfect rest, as the mind may be active in dreams and the body may move. But it must be granted that normal sleep approaches more nearly the ideal rest conditions than the waking state.

Practically all the physiological theories of sleep attribute its onset to either a diminution of energy-producing material or an accumulation of fatigue by-products. These conditions in one way or another, differing according to different theories, produce the state of unconsciousness called sleep. Although there is much doubt about just what sort of circulatory changes take place in the sleep state, evidence is not lacking to show an increased rate of repair. For in-

stance, one study ¹⁹ of the circulation of the blood in the brain during sleep shows that, contrary to the prevailing belief, the amount of blood in the cerebral vessels increases during sleep. "If any special utility is to be assigned to this fact (increased blood supply to the brain during sleep), it may be that the effective building up of energy-giving substance in the brain requires greater circulation than is demanded by other parts."

If sleep results from fatigue and constitutes a process of repair, then, obviously, the amount of sleep must depend on the amount of cumulative fatigue. This not only differs for various kinds of work, physical and mental, but differs widely with the individual. Some persons seem to preserve the balance between waste and repair more perfectly than others, hence have less cumulative fatigue and need less sleep. If the rate of waste and repair for a given type of activity can be equalized, the knowledge of the means would be of immense value. An approximation to this balance is obtained by the adoption of rest periods in the midst of work. There is no doubt that the proper regulation of work periods and rest periods will do much toward the elimination of cumulative fatigue.

The exact amount of sleep required will always remain a problem to be solved for each individual case. It must be sufficient to keep him in a state of physical and mental efficiency, this to be determined by the amount and quality of work done over a long period of time. In no case should the tests be limited to periods as short as a week or two weeks, for cumulative effects might be harmful and not show themselves in this time.

The most recent conclusions concerning the effects of sleep have been obtained by finding the influence of loss of sleep upon mental and physical functions. Such studies have

¹⁹ J. F. Shepard, *The Circulation and Sleep* (The Macmillan Co., New York, 1914).

shown quite uniformly that sleepless periods of 60 to 120 hours produce no serious disturbances in performance of work. A very vital factor in such results is the capacity to produce sudden spurts of power under even the most adverse conditions. Its importance has been recognized in the study of all work conditions, and undoubtedly plays a part in studies of loss of sleep. It has been found in one of these, for instance, that the naming of one hundred colors was not disturbed by lack of sleep, but the naming of 1,200 colors was disturbed, requiring more time and showing an increase in the number of errors. The power of sustained attention is affected, while the power for short spurts of attention is not disturbed.²⁰

One case in which the effects of loss of sleep were measured in terms of metabolism instead of output of work confirms the statements just made. Laird and Wheeler²¹ measured, in terms of energy consumed, the influence of a loss of two hours of sleep upon ability to solve problems in multiplication. Whereas there was no change in output of work, each unit of work done was found to cost just about three times as much in energy. Although the excess of energy expended was relatively slight when expressed in calories, an accumulation of these slight amounts over a period of weeks might be harmful.

The question whether recuperation takes place uniformly throughout the whole period of sleep is one that can be answered only indirectly. Many measurements have been made of the depth of sleep and there is general agreement that the deepest sleep occurs during the first hour and then gradually decreases during the remaining hours. But whether

²⁰ M. A. M. Lee and N. Kleitman, "Studies in the Physiology of Sleep," *American Journal of Physiology*, Vol. LXVII (1923), pp. 141 ff.; E. S. Robinson and S. O. Hermann, "Effects of Loss of Sleep," *Journal of Experimental Psychology*, Vol. V (1922), pp. 19 ff.

²¹ D. A. Laird and William Wheeler, Jr., "What It Costs to Lose Sleep," *Industrial Psychology*, Vol. I (1926), pp. 694 ff.

recuperation occurs more rapidly in the period of deepest sleep or not is uncertain. The investigator quoted earlier says that sleep becomes lighter probably because of the elimination of a quantity of waste products. However, the slight benefit obtained from sleep broken into short periods has suggested that the real anabolic processes do not become very effective until after this period of deep sleep has passed.

SOURCES OF THE PRODUCTS OF METABOLISM

The energy-producing material for muscle and nerve, as well as the material needed for structural growth, is supplied from food and air. Consequently, the quantity and the quality of the food consumed and the air breathed are factors not to be neglected in the production of efficiency. The latter factor will be discussed in a succeeding chapter in connection with the broader question of the influence of climate and atmospheric conditions upon efficiency.

The efficiency value of foods for the upbuilding of the body has received much attention of late, especially on account of economic pressure and the high cost of living. The evaluation of foods of all kinds as body builders has been taken up seriously by the Federal Department of Agriculture, and valuable bulletins concerning their findings may be had for the asking. Much of what follows is gleaned from this source. People may be divided into three groups on the basis of their eating. First, there is the extreme in which palatability or pleasure in eating alone regulates the diet in quality and quantity. This group represents the majority of people. Second, there is the opposite extreme in which all the fads and fantastic statements about diet are heeded. And there have been many of these fads in recent years. One's common sense can usually be relied on to warn him that, if such doctrines were true and important, the race could hardly have survived its dietary indiscretions. Fortunately, between these extremes, there is a constantly increasing third

group including those people who are learning the fundamental principles of dietetics. Perhaps the most fundamental of all these principles is that food "must supply a great variety of chemical substances combined in different ways for the structural needs of the body, and also must supply it with energy-yielding substances with which it may perform external and internal work. It seems apparent that a varied diet, reasonably generous in amount, is more likely to meet the body needs than one restricted or unvarying in its make-up or scant in quantity. The more knowledge and judgment used in its selection, the better the diet is likely to be."

The kind of food, the amount taken at a meal and the number of meals per day are largely a matter of custom. But fortunately the number of meals per day and the relative size of them do not greatly influence the total amount of food consumed per day, "for the man who goes without his breakfast is very likely to make up for it at dinner or supper, while the man who eats an early breakfast and then a second breakfast will be likely to take a moderate lunch or a light dinner."

Space will not permit a discussion of the value of specific foods in terms of energy units, and their proper combination into menus suitable for different individuals. Obviously, the food requirements vary with difference in size, age and occupation. Tables of food requirements have been computed for "a man in the period of full vigor, weighing 150 pounds and engaged in moderate to active muscular work." Means of computing the needs for those varying from this standard have also been worked out. Such facts in convenient form are available elsewhere.

Certain matters of broad application may be mentioned. Foods may be grouped roughly into five classes: (1) Flesh foods, including milk, cheese, eggs and certain meat substitutes such as nuts, beans, peas, etc. (2) Starchy foods.

(3) Fat foods. (4) Watery fruits and vegetables. (5) Sweets. And it may be taken as a general rule that each one of these classes of food should be represented, if not at every meal, at least once a day, and that if an excessive number of food materials from any one group are used in the course of a day the result is likely to be unsatisfactory from the standpoint of rational dietetics or of taste.

Finally, meals constructed upon the above broad basis may be one of two types, the "restaurant" type or the "family" type. In the first, the principal dish is a meat order, supported by potatoes, a green vegetable, bread and butter and a dessert. In the second, the meat is relatively less important, with a much larger quantity and variety of vegetables, bread, butter and a dessert.

If we follow the rapidly gaining theory that foods, like meat, which yield an acid residue when assimilated, should be accompanied by a generous amount of foods, like vegetables and fruits, which yield a distinctly alkaline residue when assimilated, the wisdom of the so-called household type of meal is apparent. We shall find also, if we consider its chemical composition and energy value, that it is more likely than the other type to supply in reasonable proportion the necessary building and repair material and the energy-yielding substances required.

We may take it as a safe guide that our food should be of good quality, varied in character, with meats well balanced by vegetables and fruits, ample in quantity, the exact amount depending on the nature of the individual's activities. Whether these conditions are fulfilled may be measured by the state of the health, maintenance of a standard weight, and a standard efficiency measured in terms of productivity.

In any consideration of food values it is well to remember that the important fact is not how much food and what kind is consumed, but what proportion of it is actually transformed into tissue and fuel within the body. This assimila-

tion of food for body needs depends most directly upon the proper functioning of the digestive mechanism. Recent studies, moreover, have shown that the state of mind has much to do with the proper digestion and assimilation of food. Every one knows that great fear will cause the tongue to cleave to the roof of the mouth from inhibition of the flow of saliva, and that the mere sight of a lemon will cause a copious flow of saliva. Not only this, but the other digestive juices are affected in the same way. Experiments upon man and animals have further shown that the rhythmic movements of the stomach and intestines which normally occur during digestion and are a necessary part of the process, may be completely inhibited as a result of emotional disturbances. Whether food shall be made available for body needs depends, then, among other factors, upon whether we are cheerful or sad, fearful, angry or calm, tired or rested. It behooves us for purely economical reasons to make the most use of the mental control over digestion. Variety in the preparation of foods, with the use of sauces and flavors, æsthetic effects in its presentation through clean linen, pretty dishes, decorative devices and every other appeal to the appetite, are in the end an economy. Likewise, sociability, music, pleasant surroundings, freedom from fatigue and worry and other means of producing good cheer are aids to digestion not to be overlooked.

CHAPTER X

THE INFLUENCE OF ENVIRONMENTAL CONDITIONS: I. VENTILATION

THE behavior of living organisms cannot be considered apart from the environment in which their reactions occur. Native endowment and training up to the moment of action lay the conditions and predispose for certain kinds of behavior, but the particular quality and amount of reaction that actually occurs depend upon the interaction of these forces. Environment is here used in a very broad sense and includes the envelope of air surrounding the body, as well as its clothing, the quality and quantity of the illumination, natural or artificial. It includes the individual's human and animal neighbors, and all the stimuli that are playing upon his special senses. The list is, consequently, extremely long, although the influence of many items in the list is too slight to be of practical importance. It is essential, however, to go beyond the general notion that some environmental factors are good or bad, and to find out to just what degree our daily work and play are affected by them, and just which ones are vital enough to warrant efforts toward their control in particular circumstances. The search for means of increasing efficiency in business, in industry and in the public schools, and for means of raising the level of general health and comfort has led to the investigation of some of these environmental forces, with interesting results. Noises, smoke, gasoline fumes, quality, quantity and sources of light, temperature and humidity, the rhythmical alternation of day and night, and many others are objects of attack in research

laboratories and in the field. Some of the more important of these conditions will be examined in this and the succeeding chapters.

The condition of the air in which one lives has been recognized as a factor in efficiency since the Seventeenth Century. The tragedy of the Black Hole of Calcutta, more than one hundred and fifty years ago and pictured in the following paragraph,¹ has frequently served as an example of the effect of lack of ventilation.

One of the hottest of the hot nights of British India, a little more than one hundred and fifty years ago, Siraj-Uddaula, a youthful merciless ruler of Bengal, caused to be confined within a small cell in Fort William one hundred and forty-six Englishmen whom he had that day captured in a siege of the city of Calcutta. The room was large enough to house comfortably but two persons. Its heavy door was bolted; its walls were pierced by two windows barred with iron, through which little air could enter. The night slowly passed away, and with the advent of the morning death had come to all but a score of the luckless company. A survivor has left an account of the horrible happenings within the dungeon, of terrible strugglings of a steaming mass of sentient human bodies for the insufficient air. Within a few minutes after entrance every man was bathed in a wet perspiration and was searching for ways to escape from the stifling heat. Clothing was soon stripped off. Breathing became difficult. There were vain onslaughts on the windows; there were vain efforts to force the door. Thirst grew intolerable, and there were ravings for the water which the guards passed in between the bars, not from feelings of mercy but only to witness in ghoulish glee the added struggles for impossible relief. Ungovernable confusion and turmoil and riot soon reigned. Men became delirious. . . . All efforts for relief were vain until at last bodily and mental agony was followed by stupor.

¹ F. S. Lee, "Fresh Air," *Popular Science Monthly*, Vol. LXXXIV (1914), pp. 313 ff.

EARLY EXPLANATIONS OF THE EFFECTS OF POOR VENTILATION

One need only appeal to his own experiences for proof that being confined in a crowded, poorly ventilated room produces drowsiness, lassitude, and even severe headache or fainting. To correct the evil, it is not enough to blame the bad air—one must know just why the air is bad, what makes it bad. Mere opinion and popular prejudice cannot be relied on to discover the cause, but the results of scientific experiments must be sought. One of the earliest explanations of the effects of bad air, before chemical analysis of the atmospheric air had been made, was that the human body exhausted the aërial spirit of the air, a substance necessary for the preservation of life. Another view was that the human body gave off noxious vapors which poisoned those persons inhaling them. After the analysis of air into its chemical constituents, the aërial spirit needed to preserve life became oxygen and the noxious gases became carbon dioxide. The effects of bad air were then thought to be due to the decrease of oxygen and the increase of carbon dioxide components of the air. This is the view that is prevalent in the popular mind to-day. Experimental work, however, does not support this theory. Pure air contains, among other constituents in small proportions, the following:

Oxygen	21	per cent
Nitrogen	78	“ “
Carbon dioxide	0.03	“ “

Now in the most poorly ventilated schools and factories the oxygen is reduced to only 19 per cent and the carbon dioxide is increased to only 0.3 per cent. But in order that any harmful physiological effects can be demonstrated, the oxygen must be reduced to 14 per cent and the carbon dioxide increased to 2.4 per cent. It is clear from such figures that the ill effects from poorly ventilated rooms cannot then be

attributed to reduction in oxygen nor to increase in carbon dioxide, nor even to a combination of both.

The theory of "crowd poison," as it was called, next developed and received much support even as late as 1911. According to this theory organic matter given off by the lungs and the body surface contained a poison, called anthropotoxin. The odor of foul air was supposed to be an index of the presence of this poison. Definite proof of this theory seemed to be obtained by condensing expired air and administering the solids and liquids obtained to guinea pigs. Ill effects thus produced were attributed to the presence of the anthropotoxin. Later experiments showed that the technique of these tests was in error and that the conclusions were false.

Moreover, experiment has shown that air is almost never directly responsible for carrying disease germs of any kind. When transmission by way of dust particles, by insects, and by actual contact has been eliminated there is little transmission of disease germs. Lee² speaks as follows concerning infection by way of the air:

The mere fact that such germs (as tuberculosis, diphtheria, typhoid fever, dysentery, etc.) have at times been found (in the air) is of little significance in the matter of possible aërial infection. They never occur in any considerable numbers, and considerable numbers of germs are usually necessary to produce disease. It is known that many bacteria on being cast out into the air from an infected source lose their virulence in the process of drying, and soon die. Evidence that these disease germs pass through the air from room to room of a house or from a hospital to its immediate surroundings always breaks down when examined critically. It is, indeed, not rare now to treat cases of different infectious diseases within the same hospital ward. The one place of possible danger is in the immediate vicinity of a person suffering from a disease affecting the air passages, the mouth, throat or lungs, such as a "cold" or tuberculosis. Such a

² F. S. Lee, *ibid.*, pp. 313 ff.

person may give out the characteristic microbe for a distance of a few feet from his body, not in quiet expiration, for simple expired air is sterile, but attached to droplets that may be expelled in coughing, sneezing or forcible speaking. But apart from this source, there appears to be little danger of contracting an infectious disease from germs that float to us through the medium of the air.

Infection from sewer gas escaping from defective plumbing is a negligible quantity in the transmission of disease. Workmen in sewers are notoriously strong, vigorous, healthy men, with a low death-rate among them.

PHYSICAL THEORY OF VENTILATION

If bad air is not bad on account of its chemical constitution, low oxygen content, high carbon dioxide content, or the presence of toxins, what is the cause of the indisputable ill effects of poor ventilation? Chemical theories have been replaced by physical theories, and the problem is transferred from chemistry to physics. The air is considered as a radiating medium by which the body may maintain a so-called normal temperature, set by nature at 98.6° F. When the temperature rises above this normal the subject is said to have a fever, or when it sinks below this normal, he has a "chill." Either condition is destructive to the bodily well-being, the life of the individual cells depending on a maintenance of this norm. Fever is accompanied by abnormal chemical changes within the tissues and the production of toxic substances, which in turn react upon the tissues, diminishing their working power, inducing early fatigue, and upsetting the normal equilibrium of the organism.

The body is constantly producing more heat than is necessary for maintaining this normal temperature, as a result of muscular, nervous and glandular activity. The excess is given off partly by way of the warm expired air, but largely by convection (air currents), by radiation from the body surface and by evaporation of the perspiration thrown out

upon the skin by the sweat glands. These three processes of convection, radiation and evaporation depend not only upon the body and its condition, but also upon the condition of the air surrounding the body. If, for instance, the temperature of the air is higher than that of the body, direct radiation from the body to the air does not occur, but rather the opposite. Further, if the air is already saturated with moisture, evaporation cannot occur. In this state the two most important factors in maintaining a normal body temperature are absent, and the body suffers from overheating. It is this overheating which causes the lassitude, drowsiness, headache, etc. Thus it may be said that the two conditions of the air in which one is required to live, which demand attention, are temperature and humidity, and not chemical constitution.

Any careful observer will discover that the interrelation between temperature and humidity as factors in body heat regulation is not simple. He will discover that a high humidity with a fairly high temperature increases the feeling of warmth, while a high humidity when the temperature is lower produces the feeling of cold. Compare the effects of moisture in the air on a warm summer day and on a cool spring day. Now, humidity not only reduces the rate of evaporation of moisture from the body surface and exerts a warming influence, but it also increases the heat conductivity of the air and thereby exerts a cooling influence. Which effect will be dominant depends upon the prevailing temperature. Below 70 degrees F., the heating effect of increased humidity is negligible while its cooling effect through increased radiation is great. Above 70 degrees F., on the other hand, the cooling influence of increased radiation is very slight, while the inhibition of evaporation greatly increases the feeling of warmth. At about 68 to 70 degrees F. there is a neutral zone, where humidity has relatively little effect.

The experiments conducted by the New York State Ventilation Commission * have demonstrated that, if a number of individuals are kept in an air-tight chamber with the air unchanged for a number of hours, they show the usual symptoms of poor ventilation. If they are allowed to breathe fresh air by means of tubes leading from the outside of the room, these symptoms do not disappear. And, if an individual on the outside of the room is required to breathe the much-used air from within the room by means of tubes, he does not show the symptoms. Hence the character of the air that is breathed is not the cause of the symptoms. The experiment room, used by the New York Ventilation Commission, was equipped with devices for changing the air in any fashion, e.g., temperature, humidity, stagnancy, etc., and the effects of each change could be determined. Any change which will produce the necessary radiation of heat from the body has been found to reduce the unpleasant symptoms. Thus stirring or disturbing the air with electric fans, thereby driving the hottest air away from the skin, will bring relief at once.

INFLUENCE OF VENTILATION CONDITIONS UPON PHYSICAL WORK

Thus far we have considered the feelings of discomfort resulting from poor ventilation. Quite as important are the effects upon the quality and the quantity of work done. The ventilation studies just referred to have found that a diminished capacity for physical work accompanies the feelings of discomfort. The work consisted in periodically lifting a 5-pound dumb-bell through a distance of $2\frac{1}{4}$ feet, making 11.25 foot-pounds of work per lift. The report concludes as follows:

* "Ventilation," *Report of the New York State Commission on Ventilation* (E. P. Dutton and Co., New York, 1923).

When men were urged to work they accomplished 28 per cent less total work in a day in an atmosphere of 86 degrees F., 80 per cent relative humidity, than at 68 degrees F., and 50 per cent humidity. When left to themselves, but stimulated by a bonus, they performed per man per hour in the four atmospheric conditions of 68 F. fresh air, 68 F. stagnant air, 75 F. fresh air, and 75 F. stagnant air, the decreasing series of 100, 91.1, 85.2, and

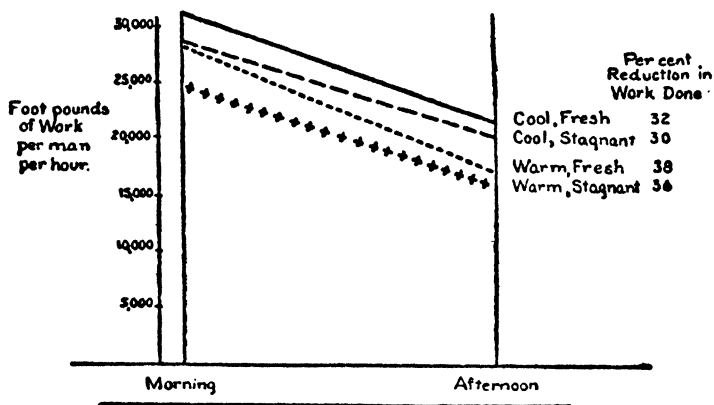


FIG. 10. EFFECTS OF AIR CONDITION UPON PERFORMANCE

76.6 percentages of work. During the warmer hour, regardless of whether fresh air was supplied or not, the subjects performed 15.4 per cent less work than during the cooler hour. With no fresh air supplied, regardless of the two temperatures employed, they performed 9.4 less work per hour than when abundant fresh air was given them. In stagnant air at the lower temperature they performed 8.1 per cent, and at the higher temperature 10.1 per cent, less work, than when fresh air was supplied. While in the cooler air the afternoon hour, when fatigue was present, if compared with the forenoon hour, irrespective of air supply, showed a falling off of 31.8 per cent of work; in the warmer air, the fall was as much as 36.9 per cent.

Figure 10⁴ shows these data graphically.

⁴ *Ibid.*, p. 95.

Recent field studies in industry have shown that the temperature and humidity of the worker's environment through their influence upon body temperature play an important part in determining output. Figure 11⁵ shows the variations in output of millworkers engaged in the manufacture of tinplate at different seasons of the year. The scale on the left indicates the relative output, that on the right shows the temperature, and the scale along the base line shows the months of the year during which output was measured. The

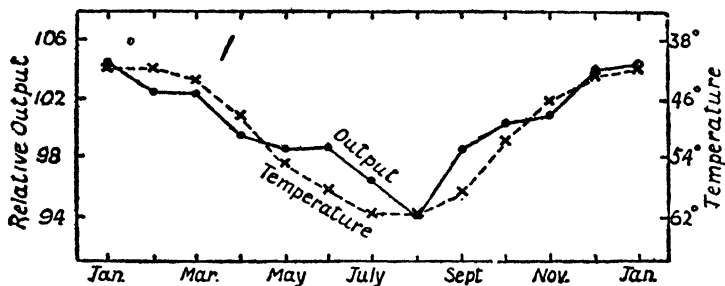


FIG. 11. RELATION BETWEEN OUTPUT AND SEASONAL VARIATION IN TEMPERATURE

solid line representing the output follows very closely the course of the dotted line which represents temperature. It should be noted that output in this type of work which is very heavy is greatest when the temperature is lowest. In light operations such as silk weaving the optimum temperature is relatively high.

When ventilating devices are employed, a large part of the seasonal variation indicated in the chart may be eliminated and the output kept near that of the optimum season. For example, in the tinplate mills output was measured under ventilated and unventilated working conditions.

⁵ H. M. Vernon, "The Influence of Hours of Work and of Ventilation on Output in Tinplate Manufacture," Industrial Fatigue Research Board (London, 1919), No. 1.

It was found that in two unventilated factories the average output was, respectively, 11 per cent and 18 per cent less in the hottest weeks of the year (when the mean temperature was 65 degrees F. or more) than in the coldest weeks (when the temperature was 40 degrees F. or less). In the ventilated factories it was only 8 per cent less. The conclusion is drawn that thoroughly efficient ventilation may be expected to increase the average output of a previously unventilated factory by 12 per cent or more. The primary effect of the type of ventilation used in this study was movement of the air which reduces the body temperature by increasing the rate of evaporation from its surface.

The English investigators attach great importance to ventilation as an efficiency factor, and in their field studies they make use of the Kata-thermometer^{*} for making more delicate diagnostic measurements than can be obtained with the ordinary thermometer. This instrument measures the power of the atmosphere to cool the skin surface, a function which depends upon the temperature, the humidity and the rate of movement of the air. The temperature and humidity of the work room, when air movement is disregarded, does not give a satisfactory measure of cooling power. The use of this instrument has shown that the atmospheric conditions vary considerably from one part of the work room to another, so that the conditions for a worker may be much more unsatisfactory than a casual ventilation survey of the room would indicate. In the neighborhood of machines, especially, the conditions are likely to be found unsatisfactory. Tentative norms for rate of cooling have been established for several occupations, for different seasons of the year and for different types of building.

^{*} For a detailed description of this instrument and its use, see W. D. Hambly and T. Bedford, "Preliminary Notes on Atmospheric Conditions in Boot and Shoe Factories" (Industrial Fatigue Research Board, London, 1921), Report No. 11. (See also Report No. 21.)

INFLUENCE OF VENTILATION CONDITIONS UPON MENTAL
WORK

The results of the experiments of the New York State Ventilation Commission upon mental work are in strong contrast to their findings for physical work. A variety of mental operations ranging from the simple cancellation of numbers to complex judgments of specimens of composition, were investigated under extremes of temperature and humidity. It was found, for example, that when an individual is urged to do his best, he does as much and does it as well, and improves as rapidly, when the air is hot, humid, stale and stagnant (86 degrees F. and 80 per cent humidity, with no fresh air or air movement) as under optimum ventilation conditions (68 degrees F., 50 per cent humidity and plenty of circulating fresh air). Furthermore, when the tasks are of no interest to the worker and when he has no means of judging of the quality of his work, and lacks any other spur to good and steady work, he still shows no inferiority in the quality of his work under the worst conditions as contrasted with the best conditions. There was some evidence of slower work or more frequent rests under the worst conditions, but such was not uniformly the case.

In one series of experiments in which the temperature alone was varied from 68 F. to 75 F., and in which the individual was left to his own choice as to whether to do mental work, read stories, rest, sleep or talk, he did as much work under the warm as under the cool conditions. However, in another experiment where both temperature and humidity were high (86 F. and 80 per cent humidity) there was a diminished inclination to do mental work. It was found further that the more devoid the activity was of muscular activity the less it seemed to be affected by atmospheric conditions. "Purely mental work may be considered as perhaps furnishing a certain amount of distraction under

uncomfortable atmospheric conditions, but as soon as heat-producing muscular work is involved the scale tips the other way." Although the report recommends that these studies be repeated over a much longer period of time, because the rise in body temperature and changes in the circulation of the blood might have some cumulative effects upon mental activity that do not manifest themselves in a short time, the findings on the whole were considered negative. The concluding paragraph of the report is as follows:

It may be that the custom of relaxing or intermitting mental work in response to hot skin, flushed face, perspiring body, and the like gives no evidence that mental work is any more taxing or injurious than at cooler periods. The higher body temperature, circulatory changes, and sensory discomforts probably are taxing, but we lack evidence that their presence makes the same mental productivity different in its nature or consequences from what it is in cool air. The discomforts to which men have responded by ceasing mental work might perhaps better be responded to by working to pay for an electric fan, taking cool baths, or thinking out ways to reduce the physical exertions which accentuate the discomforts. Merely to postpone useful thought to a cooler period may leave the net total of discomfort unchanged or even increase it.

THE INFLUENCE OF CLIMATE UPON EFFICIENCY

Climates differ from one another, and seasons likewise, in four respects; namely, temperature, humidity, barometric pressure and wind. The influence of climate and season of the year, consequently, reduce largely to a question of temperature and relative humidity, and to that extent are covered by the previous discussion. But some consideration must be given to the statistical researches upon the influence of climate and season, if only to corroborate the experimental results. Aside from differing in the method of obtaining the data, the two sorts of study, namely, that of ventilation and that of climatic conditions, differ in that

the latter are concerned with the supposed results of subjection for long periods of time to certain atmospheric conditions, and the former with results for relatively short periods. The supposed effects of climate upon civilization are thus summarized by Huntington:⁷

In their effects upon the race . . . varying temperatures have been recognized by every student of climatology. Inhabitants of hot climates are apt to be listless, uninventive, apathetic and improvident. An equable high temperature, especially if moist, weakens body and mind. No long-established lowland tropical people is a conquering race in the broadest sense of the word. For the inhabitants of the higher altitudes, even under the tropical sun, this may not be true; for as we ascend, the temperature lessens about 1 degree every 270 feet on an average, and even at the equator we may have a temperate climate. The most favorable temperature for health that carries with it an aggressive energy which is felt, and which has led the world march of civilization, is about 55 to 70 degrees Fahrenheit, on an average, and this is found in the temperate zones. . . . The dominant peoples are found between the latitudes of 25 and 55 degrees. Farther north the available vital energy seems so largely expended in furnishing mere body heat and stimulus for the necessary physiological functions that there is little left for use in those activities which make leaders. . . . Excessive heat together with high humidity forms a most deadly combination for one not acclimated to it, as the mortality on the west coast of Africa testifies; while in some localities, as for instance, Western Ireland, the lake region of England, and the extreme northwestern coast of our own country, much moisture from a great rainfall without excessive heat is not particularly unhealthful.

One objection to attaching such great importance to climatic conditions in determining the character of civilizations has been the changes in the type of civilization that have taken place in the course of centuries in the same locality. To offset this objection, however, there is the

⁷E. Huntington, *Civilization and Climate* (Yale University Press, New Haven, Connecticut, 1915).

suggestion, supported by modern researches, that climatic conditions have varied from century to century, and that "when the great countries of antiquity rose to eminence, they enjoyed a climatic stimulus comparable with that existing to-day where the leading nations now dwell. In other words, where civilization has risen to a high level the climate appears to have possessed the qualities which to-day are most stimulating."

So far as the behavior of the individual is concerned, climatic conditions which are extreme in neither direction are conducive to the greatest activity. That is, in extremely warm and humid climates and in extremely cold climates, the excess of energy supply over demand is always slight, and activity of all kinds is at a minimum. To put the matter another way, so as to relate it to our study of ventilation more closely, any atmospheric conditions which tend to change the body temperature much above or below its normal for more than a very short period of time decrease activity.

It must be remembered that great activity and large reserves of energy on which the activity depends may be turned to good or bad use. Thus Dexter⁸ attributes the excess of crimes such as murder, assault, etc., in the temperate zone, over that in the torrid or frigid zone, to this excess of energy and consequent activity. He also finds a great excess of such active crimes as assault in the summer months as compared with the winter months. On the other hand, he finds much more drunkenness in the winter season, a condition which he attributes to the low state of energy and the consequent need for stimulants. Excess of activity seems to find the readiest escape by way of the emotional states that lead to fighting.

⁸ E. G. Dexter, *Weather Influences* (The Macmillan Co., New York, 1914).

An interesting fact in connection with the relation between the curves representing temperature and those representing frequency of assaults (the latter being taken as an indication of excess energy), is that they run parallel except in exceedingly hot weather, i.e., from 90 degrees F. up there is a drop in the curve, which means a decrease in the number of assaults. This confirms the earlier statement that high temperatures as well as low ones reduce the energy supply available for activity. Huntington considers England and the northwest coast of the United States as approaching the ideal climate. The former, in the neighborhood of London and Liverpool, averages 38 degrees to 39 degrees F. in winter and 60 degrees to 63 degrees in summer; the latter (e.g., Seattle) averages 39 degrees F. in January and 64 degrees F. in July. He attributes the climatic excellence of these localities to the fact that ocean winds from the west blow freely over them.

Dexter measured the effect of season of the year upon intellectual work of a rather specific sort; namely, the calculations of bank clerks. The records were in terms of certain types of errors made. He found most errors occurring in October, November and December, and fewest in April, May and September, with the number fairly large in the hot summer months. The last he considers due to the depletion of energy from excessive heat, the good records, or few errors, in the spring and autumn due to the stimulating character of the changes in temperature. The high error record in the winter months cannot be attributed to weather conditions solely, as the whole matter is complicated by increased business, holiday seasons, etc.

THE INFLUENCE OF WEATHER UPON EFFICIENCY

Weather may be reduced to the same four conditions as climate, namely, temperature, humidity, barometric pressure and wind, the main difference being in the temporary char-

acter of weather conditions as compared with climatic conditions. On account of this variation in the weather greater opportunity is offered for study of various conditions upon efficiency. Climate is always involved with such a large number of other conditions, among them racial heredity, that conclusions are uncertain. The influences of the weather may be studied upon the same individuals under environmental conditions identical except in regard to this one factor.

The following quotations taken from a popular article give a notion of the popular opinion about the effects of weather conditions:

Nearly all vocations—some, of course, more than others—are affected by weather. Men of science are often as much subject to weather as seamen. Some writers must have the weather fit the mood, character or scene, and can do nothing if they are at variance. An adverse temperature brings them to a dead halt. If one will but read poetry attentively, he will be surprised to find how much of it bears weather marks scattered all through it. A popular writer thinks weather often affects logic, and many of men's most syllogistic conclusions are varied by heat and cold. Diverse weather states may be one cause of so much diversity and even disagreement in thought processes, usually regarded as scientific. I have collected opinions of many experienced teachers and nearly all think there should be modification of both school work and discipline to correspond with weather. Animals respond to it promptly and with no restraint, and almost constitute a sort of weather signal service if observed. . . .

An employer of 3,000 workmen is quoted as saying he "reckons that a disagreeable day yields about ten per cent less work than a delightful day," and we thus have to count this as a factor in our profit and loss account. Accidents are more numerous in factories on bad days. A railroad man never proposes changes to his superior if the weather is not propitious. Some men say that opinions reached in the best weather states are safest to invest on.

The real effects of weather upon mental and motor performance can be determined by careful experimental and

statistical studies. Unchecked opinions are as unsafe here as elsewhere. Huntington has studied more than 500 factory workers in Connecticut and 3,000 to 4,000 operatives from the southern States. He has examined the records of 1,700 West Point and Annapolis students and correlated their work on various days with the weather conditions on those days. His conclusions are as follows:

1. Changes in barometric pressure have little effect.
2. Humidity possesses a considerable degree of importance.

3. Temperature is the most important factor.

The greatest physical activity occurs when the daily temperature averages 60 degrees to 65 degrees F., with a noon temperature of about 70 degrees F. Mental activity reaches a maximum when the outside temperature averages about 38 degrees that is, when there are frosts at night. Moderate temperature changes from day to day are most conducive to activity, while great uniformity or sudden great changes are detrimental to good work.

The measurements by Dexter, mentioned above, on the effects of the season of the year upon certain specific mental activities, namely, the calculations such as bank clerks are called upon to make, and discriminations, or tests of speed of perception, are of interest in connection with our discussion of weather conditions. His results will be briefly quoted, although it must be clear that the conditions studied reduce primarily to those now under investigation by the ventilation commission. The latter work done under controlled conditions and with carefully planned technique should be given relatively great weight in drawing conclusions.

1. Increase in temperature causes an increase in errors, the increase becoming very rapid when the temperature reaches 85 degrees to 90 degrees F. At this point the excess reaches 60 per cent over the average.

2. Increase in barometric pressure increases the number of errors. Here the data are not so satisfactory and the conclusions rather indefinite.

3. High humidity, especially when accompanied by high temperature causes increase in the number of clerical errors.

4. An increasing high wind causes a decrease in number of errors. Dexter's explanation⁹ of this is as follows:

"It seems to me probable that it is an evidence of the necessity of ventilation on a large scale, such as is caused in our large cities through great movements of the wind. Such movements bring fresh air from the surrounding country to take the place of that which has been deoxygenated through combustion of all sorts, and the effects which we have shown are just what might be expected, for that oxygen is necessary to mental alertness no one can doubt."

5. The effects of the general character of the day are of interest. Cloudy days are accompanied by greater inaccuracy and rainy days show the same effect. Answers to a questionnaire led Dexter to conclude that the best mental work is done on fair days, while many bank officials are said to have observed an increase of errors in unpleasant weather.

After this consideration of the data, it seems fair to reduce climate, seasonal and weather conditions to the two conditions of temperature and humidity. Winds and barometric pressure in its causal relation to winds affect the body much as stirring the air of an enclosed room, by facilitating evaporation and heat radiation, with the consequent lowering of the body temperature. Where there is a tendency toward high body temperature there is an abnormal burning up of energy-producing material, and where there is low body temperature there is an automatic increase in

⁹E. G. Dexter, *Weather Influence* (The Macmillan Co., New York, 1914), p. 238.

physiological activity to raise the temperature, with the consequent consumption of energy. In either case the energy available for work is reduced, and this condition may account for all the effects of poor ventilation previously described.

Strong confirmation of our conclusions is derived from a recent study of the relative virulence of the influenza epidemic in various sections of the United States during 1918.¹⁰ By means of the partial correlation technique, which enables the statistician to hold in abeyance the influence of certain factors in a complex situation while studying the effect of others, the relative importance of twenty-two factors that might have influenced the course of the disease was determined. Most important of all were the weather conditions during the month just preceding the epidemic. Among these temperature and humidity were the principal factors. Wherever the weather was warm and the humidity high, the number of cases and the death rate were high; and wherever the temperature and humidity were relatively low, the opposite tended to be the case. The correlation between death rate from influenza and pneumonia and weather conditions was $+.57$. Thus, it seems probable that weather conditions which lower body resistance so as to increase susceptibility to this disease might also be expected to be reflected in the efficiency of the body in work.

RHYTHMICAL VARIATIONS IN EFFICIENCY

The testimony of individuals and the results of numerous studies of work done at different times of the day have created the impression that there are rhythmical variations in efficiency that can be capitalized. The equivalent of such rhythms of performance has been sought in changes in body temperature, pulse rate, breathing, blood pressure, etc. For

* Report of the Committee on "The Atmosphere and Man" (*Bulletin of the National Research Council*, Vol. VI (1923), No. 34.

instance, temperature, pulse and breathing rate are said to be lowest in early morning, 5 A. M., and increase gradually, reaching a maximum about 5 P. M. The death rate at various periods of the day has been taken as an indication of changing vitality or efficiency of the bodily mechanism. It has been a rather common opinion that death, excluding accidental death, of course, is most frequent at the early morning hour, 4 A. M., and consequently it has been assumed that vitality must be lowest at that time. As a matter of fact careful study of death statistics shows that the lowest death rate occurs in the early morning and the highest rate in the afternoon hours from 2 to 6, just when the physiological activities seem at their maximum. Other factors besides the bodily rhythm must, therefore, be sought as the cause of the peculiar distribution of deaths during the day.

Efficiency of the motor and mental processes at various periods of the day was studied by Marsh.¹¹ In the case of physical strength, not including endurance, the minimum efficiency occurs at the extremes of the day, with a point of high efficiency about 11 A. M., and a point of maximum efficiency from 3 to 5 P. M. As to rate of movement there is a gradual increase in efficiency during the course of the day with the maximum toward night. In accuracy of movement the maximum efficiency occurs toward noon. Increased nervous state during the course of the day would account for the increase of speed and the decrease of accuracy.

An interesting difference appears whenever mental activity is involved. Wherever the motor activity is combined with mental work as in reaction time, form board tests and the like, the course of efficiency follows that of the motor processes, with speed reaching a maximum late in the day, and accuracy in the late morning hours. In the more

¹¹ H. W. Marsh, *The Diurnal Course of Efficiency* (Science Press, New York, 1906).

strictly mental activities, such as memory, translation of foreign languages, attention, discrimination, mathematical calculation, school examinations, etc., the highest efficiency is attained in the morning hours for both speed and accuracy.

A large number of adult students and authors were questioned concerning the time of their maximum efficiency, and the majority considered it to be the morning hours. Preference of working hours, however, may represent largely the influence of habit, rather than any actual difference in efficiency. Thus students attending classes constantly during the day may get the habit of working at night and feel less efficient at any other time. Individual choice of working hours may be further influenced by such factors as age, sex, fatigue, etc.

Such differences of efficiency in the course of a day, if established beyond question, would be of considerable value for practical work. Perhaps the most direct application can be seen in school work where mental work would be done best in the morning hours and motor activities best in the afternoon hours. But many applications of the facts might be made to industrial activities also. A test of the output of magazine stitchers whose work is motor, with speed an important factor, showed that in the early morning hours the productivity was about 6 per cent below the average for the day, and 10 to 12 per cent below the maximum efficiency for the day, which occurs toward late afternoon. Thus if the working day of magazine stitchers were to be shortened, it should be shortened at the morning end of the day where efficiency is lowest. Data concerning the daily work curves in industry and the effects of shortening the work day are presented in Chapter XVIII. Figure 36 (page 382) should be examined as it is the typical form taken by daily output curves in a great variety of industrial operations.

Is this rhythm of efficiency discussed in the preceding paragraphs due to the nature of the physiological mechanism,

or is it due to the relation between the hour of the day and the amount of work which has been done up to that time? In other words, is this daily efficiency curve after all only a work curve? The test made by Hollingworth¹² upon ten individuals for a period of ten days, two days of which consisted of twelve hours each of practically continuous work, offers the best material for answering this

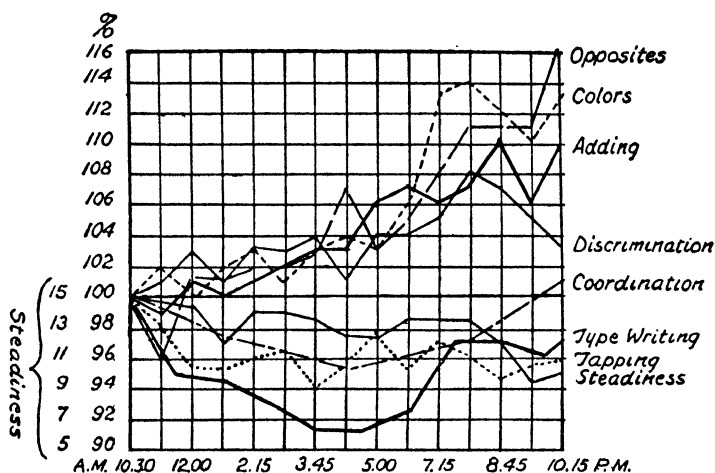


FIG. 12. CHANGES IN EFFICIENCY DURING CONTINUOUS WORK

question. His general conclusion is that the efficiency at any period of the day depends not on any organic rhythms, but rather upon the amount of work or activity which has preceded that period. For when the work begins at 10:30 A. M. the same sort of curve of efficiency for the day is obtained as when it begins at 7:30 A. M., except that it is shifted ahead just that much. One could not suppose that

¹² H. L. Hollingworth, "Variations in Efficiency during the Working Day," *Psychological Review*, Vol. XXI (1914), p. 473. For similar results see A. I. Gates, "Variations in Efficiency during the Day," *University of California Publications in Psychology*, Vol. II (1916), pp. 1 ff.

the rhythmic organic processes independent of work done or fatigue produced could thus shift.

Figure 12 contains average curves for all the persons tested. The kind of work is indicated on the right of the chart and the time of day on the horizontal scale. The vertical scale indicates the time required per unit of work, expressed in terms of per cent of the first test. None of the functions represented here shows the variations commonly seen in industrial work curves. (Figure 36.) The difference is due mainly to the powerful stimulus to good records under which Hollingworth's subjects worked, and which are absent in the routine daily activities of the industrial worker.

The contrast between the period of maximum efficiency for motor and mental activity appears in Hollingworth's, as in Marsh's, results. The data show further that subjects doing work essentially mental in character and working under uniform conditions, with a maximum of interest and incentive, show an average decrease, from the maximum efficiency, of 10 to 15 per cent in the course of a day's work. This result appears only after the possibility of improvement by practice has been eliminated. The experiment by Hollingworth is practically the only one of its kind covering a long period of time which eliminates the complicating factor of practice effect, and consequently, considerable value must be attached to these conclusions, in comparison with those experiments where practice was not eliminated.

Although experimental work does not demonstrate a perfect relation between certain rhythmic bodily processes and mental and motor efficiency, it does show that mental work reaches its maximum in the morning hours and motor work, including speed and strength, exclusive of endurance, reaches its maximum late in the day. The question of motor accuracy, represented by the steadiness of the hand in maintaining a given position is still uncertain as the two experiments quoted differ in their conclusions.

CHAPTER XI

THE INFLUENCE OF ENVIRONMENTAL CONDITIONS:

II. ILLUMINATION

THE increase in manufacturing and industrial work requiring close visual control, the increase in the volume of reading matter and its accessibility to all people, and the improvement in the means of artificial lighting, all contribute to magnify the importance of illumination as a factor in efficiency. The improvements in artificial lighting devices have not only tended to cause the substitution of artificial light for daylight, but have tended to increase the amount of night work where only artificial illumination is possible.

A great variety of problems has been presented to the illumination expert. Some of them have been answered by careful experiments and some are still unanswered. All of these problems have a direct psychological bearing, and many of them are being investigated by psychologists. The feelings of discomfort and the sense of effort from work under poor illumination are sufficient to attract attention to these problems. In addition, the lowered visual efficiency resulting from eyestrain, and its widespread effects upon general physical and mental health lend a very practical value to the investigation of them. Such problems as the following have been subjected to laboratory investigation, and useful data are available for application in the factory, business office, the school and the home:

- (1) How do daylight and artificial light compare in value for vision?
- (2) What are the best daylight conditions for work?
- (3) What is the best kind of artificial lighting?

(4) What is the proper location of lights with relation to the worker? (5) What are the effects of improper and insufficient illumination? (6) How shall the relative value of different kinds of light be measured? (7) Is the best light for the finest work also the best for less fine but long-continued work? (8) How bright should light be for the best results? (9) Does colored light have any practical value as compared with white light?

CHARACTERISTICS OF VISION AND ILLUMINATION

The most effectual lighting methods are conditioned by certain characteristics of the visual mechanism, which are innate and consequently common to all human beings. A description of these characteristics will clear the way for a discussion of illumination problems. First among these conditions is the instinctive tendency to turn the eyes toward bright objects in the field of vision, so that the light shall cast an image upon the center of vision, which is the region of clearest vision upon the retina. This turning of the eyes is synonymous with visual attention; it appears soon after birth and is one of the first signs of the infant's attention to its surroundings and its discrimination of objects. Not only does it appear early, but it is never completely outgrown. The actual movements may be inhibited, not, however, by a failure of the muscles to contract, but as a result of the voluntary contraction of antagonistic muscles. Any attempt, then, to prevent this instinctive act of attention, if it succeeds at all, requires extra muscular effort voluntarily controlled, and consumes energy.

The second important characteristic of the visual mechanism is the nature of the sensitivity of the retina to light. The main point to be noted in this connection is that the retina differs considerably in sensitivity in its different parts. It is commonly supposed that, because one can see most distinctly when looking directly at any object, the part of

the retina thus concerned, the so-called center of vision, is also the most sensitive. This, however, is not the case, for the region around the central one is much more sensitive to light intensity. The difference may be best described by saying that the peripheral parts of the retina are always adjusted for dim or weak lights, while the center of the retina is always adjusted for bright lights. So true is this that the center of vision with which one sees best in bright lights is practically blind in dim light, while the peripheral parts are used for vision in its stead. This rather striking fact may escape our observation, yet a very simple experiment will at least give an indication of it. If one watches for the stars to appear as darkness descends in the evening, he is surprised to discover them first out of "the tail of his eye"—that is, he sees them first in indirect vision, or with the sensitive peripheral region of his retina. What are the consequences of this adjustment of the peripheral retina for very weak lights? Every one knows the unpleasant effects experienced upon coming from darkness into very bright light, a temporary blindness, or if not that, an uncomfortable glare which rather quickly disappears. Now the peripheral portions of the retina are always in this relatively sensitive state, comparable to that of the central portion of the retina after fifteen minutes in darkness. Bright lights falling upon the eyes from the side produce an uncomfortable glare.

A third characteristic of the eye is the tendency of the accommodation mechanism always to adjust itself so as to see clearly or focus properly upon the object which is being looked at or attended to. So, just as there is a tendency to turn the eyes toward a bright object in the visual field, so is there a tendency to focus upon it in order to see it clearly. This is either an instinctive reaction or it is acquired extremely early in life, and is almost impossible to overcome, as any one knows who has tried to learn to fixate a given near object while attempting to pay attention to another more

distant object. There is thus a constant conflict between the tendency to accommodate for the object of involuntary attention and the object voluntarily looked at.

A fourth characteristic is the contrast effect produced when neighboring parts of the retina are stimulated with lights of different intensities or colors. For instance, when a dark and a light object are viewed side by side, the white looks whiter and the black looks blacker than if seen alone. In a word, the contrast effect is always in the direction of the greatest opposites, a white object inducing a black by contrast, etc. This phenomenon is especially pronounced upon the peripheral parts of the retina, hence a bright object seen in an otherwise dark field has its brightness enhanced and as a result of this an uncomfortable glare is produced.

UNIFORMITY OF ILLUMINATION

From a consideration of these four characteristics of vision, we can derive one of the most fundamental and yet one of the most often violated laws of illumination, namely, *that the whole visual field should be as nearly uniformly lighted as possible*. If a person is reading in a room with a ceiling light and unscreened side lights along the walls, each one of the latter forms a bright image or a glare spot upon the sensitive peripheral part of the retina. Contrast effect with the darker background tends to make this image appear even brighter than it is. This stimulation arouses the reflex tendency to turn the eyes toward the light source, and at the same time the tendency to change the accommodation of the eye from a near point to a far point. One of three effects will be produced: the reflex responses will occur, with the consequent distraction of the attention from the book; or they will be inhibited as a result of the contraction of antagonistic muscles, at the expense of considerable strain and effort; or there will be a continual fluctuation in direction of the eyes and their accommodation from the book to

the distracting light. This muscular strain will produce pain in the eyes and head, nervousness and general fatigue, in addition to the discomfort due directly to the glare.

It is largely the value of uniformity of illumination which makes natural lighting, or daylight, more efficient than artificial lighting, because with the former an even distribution of light is more likely to be attained without intention. Even here, however, there may be a lack of uniform distribution. Wrong location of the windows and skylights, incorrect color of wall coverings and window shades and the presence of polished surfaces from which the light may be reflected may serve to weaken the advantages of natural light. Most of these faults may be corrected by simple means, such as the use of ground glass in windows, removal of polished objects or giving them a dull finish, and painting the walls a soft yellow or gray. For instance, if the walls are very dark, as with blackboards in schoolrooms, there is so much difference in the intensity of the direct light from the windows and the reflected light from the walls, that the uniformity of distribution of light is destroyed, and the evil glare effects of contrasting surfaces appear. The polished nickel trimmings of a typewriter or its glossy white keys are sufficient to add much to the strain and fatigue of a few hours' work.

It is with artificial lighting that the most flagrant disregard of this rule of even distribution occurs. In lighting from exposed sources it is not unusual to find the brightest surface from 1,000,000 to 2,500,000 times as brilliant as the darkest; and from 300,000 to 600,000 times as brilliant as the reading-page. These extremes of brightness in the field of vision are, tests show, very damaging to the eye.

Figure 13¹ shows a photograph taken in a room where

¹ See C. E. Ferree and G. Rand, "Some Experiments on the Eye with Pendant Opaque Reflectors Differing in Lining, Dimensions

TABLE XII. VARIATION OF BRIGHTNESS OF OBJECTS WITHIN A ROOM

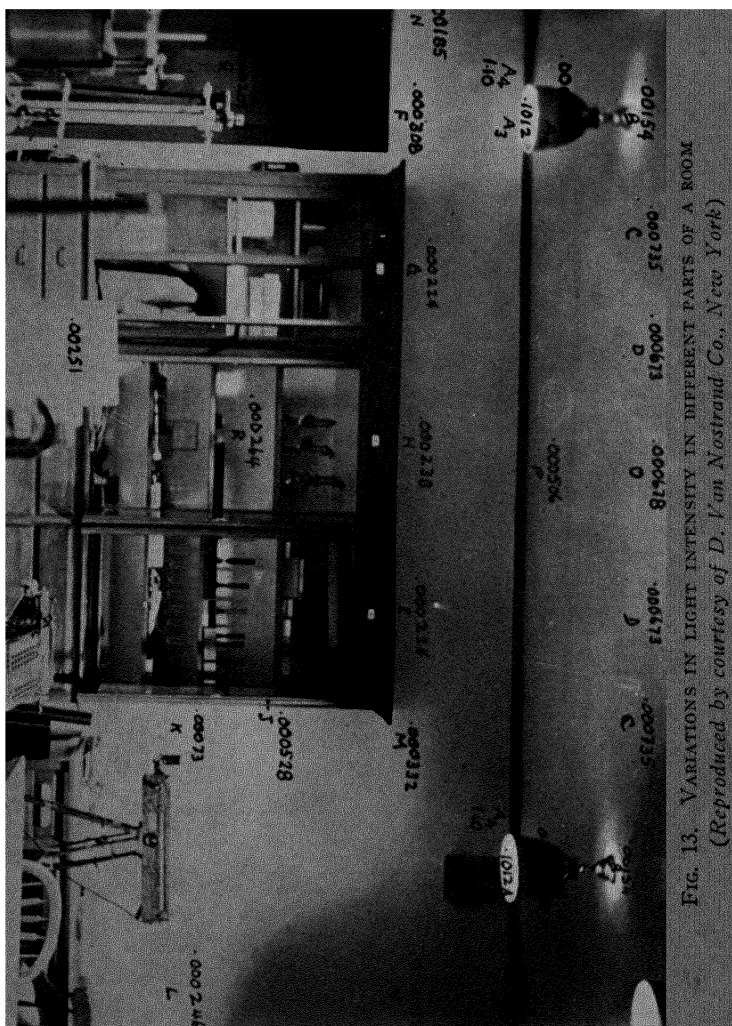
Reading Page		1.000	
Opening of Reflector		16.500	
Outside of Reflector		0.008	
Image of Lamp in Reflector		900.000	
B	0.25	J	0.08
C	0.10	K	0.10
D	0.10	L	0.04
E	0.03	M	0.05
F	0.05	N	0.03
G	0.04	O	0.10
H	0.04	P	0.08
I	0.04	Q	0.04
R		0.04	

the intensity of light at various important points is indicated in terms of candle power per square inch of surface. The shades used were of the deep bowl reflector type, the character of which may be seen from the figure. Although this reflector is far better than those ordinarily in use, as it conceals the light bulb itself from direct vision, some parts of the room were more than 100,000 times brighter than others (e.g., the outside of the shade as contrasted with the inside). The glare spots created by reflection from various objects in the room are numerous. The candle-power values of different objects in the room are given in Table XII for more ready reference, in terms of ratios of the candle power of the reading page in the usual position for reading.

UNIFORMITY OF ARTIFICIAL ILLUMINATION

It is naturally difficult to get uniformity of illumination where the sources of light are necessarily so near as they are in ordinary rooms. Many innovations in lighting sys-

and Design," *Transactions of the Illuminating Engineering Society*, Vol. XII (1917), pp. 464 f.



tems have been proposed to offset this defect. Although there are hundreds of light sources, shades and reflectors on the market, there are only three classes of illumination as far as evenness of distribution is concerned. They are the direct lighting, in which the rays of light reach the working surface without reflection; indirect lighting, in which all the rays are reflected from ceiling, walls or other surfaces before reaching the working surface; and the semi-indirect, in which part of the light is received direct and part reflected. The commonest lighting is of the first sort, where the light source is bare or has a simple shade above it. Such an arrangement will expose the eye to the direct rays of the light source and give the maximum irregularity of distribution and the maximum of discomfort. In the indirect system the light source is completely hidden, either in an inverted opaque bowl, or behind a molding of some sort. In the semi-indirect system the source is enclosed in a translucent inverted bowl so that a portion of the light comes directly through the bowl and the remainder is reflected from the ceiling. This system varies considerably in efficiency according to the translucency of the bowl. When it is very translucent it is little better than the direct system; when it is very opaque it differs little from the indirect system. The indirect system would seem to be the most efficient in spite of the fact that a greater light intensity at the source is required to allow for loss through reflection, with a consequent increase in cost.

The laboratory studies of these three systems and many other aspects of illumination that have been made by Ferree and Rand² enable us to state their relative value in terms of the working efficiency of the eye. They measured the effects of three hours of steady reading under the three sys-

² C. E. Ferree and G. Rand, "Lighting in Its Relation to the Eye," *Proceedings of the American Philosophical Society*, Vol. LVII (1918), pp. 440 ff.

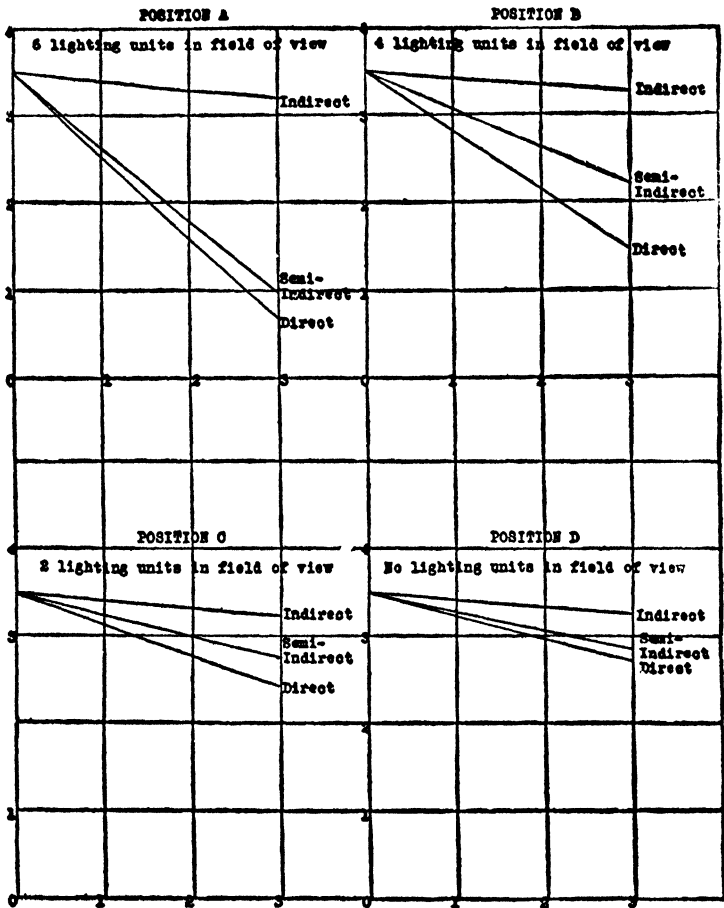


FIG. 14. CHANGES IN VISUAL EFFICIENCY DURING THREE HOURS' WORK

tems of illumination in terms of discomfort and the onset of fatigue. For the first they accepted the introspective report of trained subjects. For the second they determined the ability to sustain clear seeing during a period of three minutes. The measurements were made at the beginning

of the period and at the end of each hour thereafter. This fatigue test devised by Ferree is much better than the simple acuity test, because even when the eye is greatly fatigued it has the power to attain a high degree of acuity for just a moment. Clear seeing, however, cannot be maintained for any length of time when the eyes are fatigued. Figure 14 shows the changes in efficiency during three hours' reading for the three systems of lighting, when there is a varying number of lights within the field of vision, depending upon the position of the reader. The hours of work are given along the base line, and the degree of power to maintain clear seeing is indicated on the scale at the left. The rate of fatigue is indicated by the fall of the curve. Thus, all the curves show that there is relatively little change during the three hours' work when indirect lighting is used. The fatigue is greatest in every case for the direct lighting. Between these two lies the semi-indirect. The smaller the number of lights within the visual field the more closely do the direct and the semi-indirect systems approach the indirect. This means that the presence of the brilliant glare spots produced by the light sources is the most potent factor in fatigue. In other respects the three systems do not differ much.

While evenly distributed illumination such as is produced by daylight and by indirect artificial light properly installed gives the best results, it is worth while to consider how the system of direct lighting may be made the least offensive. This will be especially valuable if it gives to the individual a means of protecting himself against lighting conditions over which he has little control. Three possibilities present themselves. First, to lower the intensity of the light at its source, thereby reducing somewhat the unevenness of the general illumination. It is evident that this remedy can be applied only within limits, and that, as long as there is enough light for distinct vision, the bare light source will

have all the disadvantages previously mentioned. Second, by shading the eyes from the direct effect of the light. This is commonly done and does decrease the discomfort somewhat. It has been found from tests that, if eye shades are to be used, they should preferably be opaque rather than translucent and lined with white next to the face rather than with dark material. Unfortunately, most of the eye shades that are on the market are provided with a dark undersurface. Reference to the four characteristics of vision as described at the beginning of the chapter will show that the dark lining of an eye shade will decrease the evenness of illumination and produce glare by contrast between the dark surface of the shade and the light of the lamp. Moreover, the edge of the shade, being dark against the light, will serve as an object, tending to attract the attention away from the real source of interest, and at the same time tend to produce visual accommodation for this extremely near point, with eye fatigue as a result. The translucent eye shades are usually green and are good only as they approximate the opaque, but still have the disadvantage of being dark.

The third possible correction for the defects of direct lighting consists in putting shades directly upon the light. This is generally preferable to the use of eye shades and is good to the extent that it hides the bright light source and approximates the effect produced by indirect lighting and daylight. It will always be, however, only a makeshift and less efficient than the indirect lighting systems.

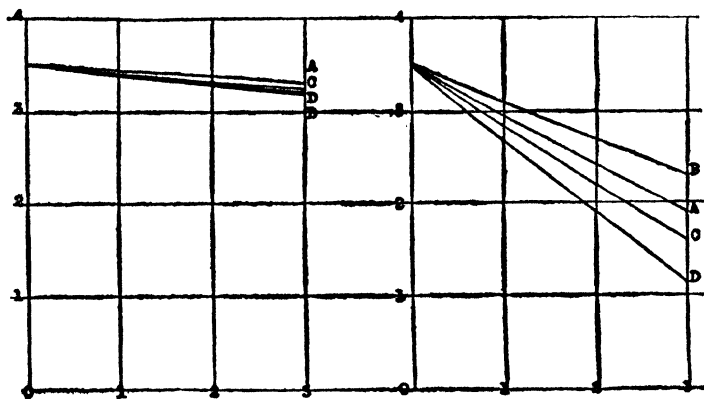
INTENSITY OF ILLUMINATION

The eye has a remarkable power of adjusting itself to changes in the intensity of the general illumination. This will be evident to any one who will note how dark an artificially lighted room appears at first when he comes into it from the sunlight, and how rapidly it "brightens up." He scarcely realizes, though, that in such a case the eye has

shifted from an intensity of about 10,000-foot candles of light to one of about 5-foot candles of light, and still maintains a serviceable visual efficiency. It seems, therefore, that within wide limits differences of light intensity are not

FIG. 15. RELATION BETWEEN RATE OF FATIGUE AND INTENSITY OF LIGHT

Lighting System: Indirect						Lighting System: Direct (8 Lamps)					
	Watts	Volts	Foot Candles		45°		Watts	Volts	Foot Candles		45°
			Vertical	Horizontal					Vertical	Horizontal	
A	200	107	1.33	0.39	0.87	A	120	107	0.64	0.32	0.49
B	320	107	1.7	0.49	1.08	B	200	107	1.16	0.45	0.85
C	480	107	3.0	0.765	1.97	C	320	107	1.97	0.65	1.39
D	800	107	5.2	1.36	3.50	D	480	107	2.60	1.02	2.0



important. It must be remembered that we are here concerned not with differences in light intensity of various parts of the visual field, but with intensities of the whole visual field at different times. What is meant is that, with even distribution of light, intensity is relatively unimportant. The great value that is commonly attached to intensity of light is due largely to the measurement of efficiency by means

of a momentary visual acuity test, whereas a more valid measure would tap the power of sustained adjustment. For reading, especially, an extremely high intensity is not necessary. Ferree and Rand³ have shown in their three-hour reading test of various lighting systems that in the indirect system, where the distribution is the most uniform, there is practically no difference in the effects of intensities ranging from 1.33- to 5.2-foot candles at the reading surface. In the direct system, however, not only are all intensities more fatiguing, but an intermediate intensity is better than either a higher or a lower one. The highest intensity was the most fatiguing. These factors are demonstrated in Figure 15, where the fall of the curve indicates loss in efficiency during a three-hour reading test. (See page 195.) The amount of current required and the foot candles of light in various positions of the reading surface are given at the top of each set of curves.

In spite of the results of these laboratory studies of the value of intensity, the fact can be demonstrated that in many industrial operations insufficient intensity of light is provided. This is especially true where a high degree of acuity is necessary for the work. In the inspection of the component parts of roller bearings⁴ for defects of material and of workmanship, efficiency was considerably raised by increasing the intensity of the illumination. The intensity of the light was increased by a series of changes, from 5- to 20-foot candles, and the effect was an increase in the average number of pieces inspected per hour per person. Figure 16 shows the per cent increase in production as well as the cost of the lighting in per cent of payroll. The area between

³ C. E. Ferree and G. Rand, "Lighting in Its Relation to the Eye," *Proceedings of the American Philosophical Society*, Vol. LVII (1918), pp. 456 f.

⁴ See Luckiesh, *Light and Work* (D. Van Nostrand Company, New York, 1924).

these two curves shows the gain in production over and above the cost of increased light. What would be the effect of further increases of intensity can only be guessed, but it is likely that a maximum would soon be reached. Studies

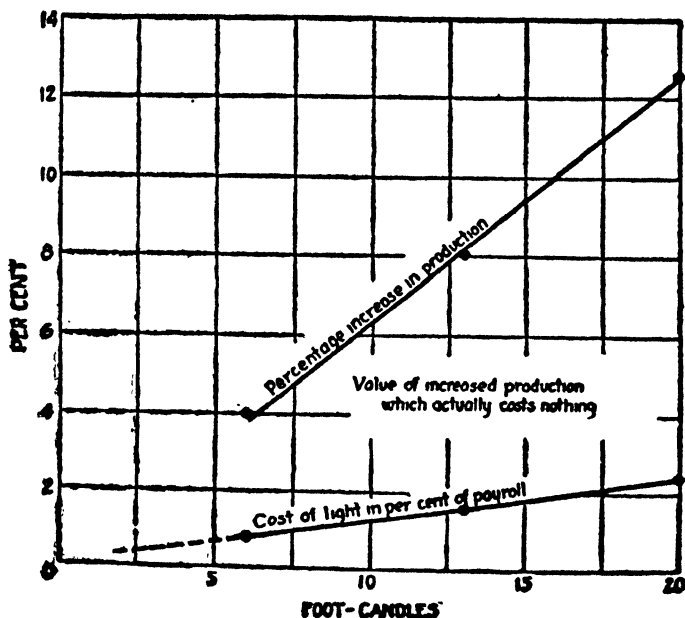


FIG. 16. INCREASE OF PRODUCTION VERSUS COST OF LIGHTING
(Reproduced by courtesy of D. Van Nostrand Co., New York.)

of change of visual acuity with increasing light intensity show that beyond a certain point the increase becomes negligible. Thus, Rice⁵ found that:

$\frac{1}{4}$	daylight acuity is obtained with about $\frac{1}{8}$ meter candle
$\frac{1}{2}$	" " " " " " 1 " "
$\frac{3}{4}$	" " " " " " 8 " "
1	" " " " " " 50 " "

⁵D. E. Rice, "Visual Acuity with Lights of Different Colors," *Archives of Psychology* (1912), No. 20.

The light intensity must be adapted to the character of the work to be done. Under certain circumstances it may not be economical to go beyond 1-meter candle, while in others, as in inspection of objects for slight defects, it may be advisable to get increased acuity even at a high cost in light intensity.

QUALITY OF ILLUMINATION

Concerning the value of different color qualities of the illumination, little is known. The restful effects attributed to the carbon lamps and the oil lamps of earlier days are doubtless due to their relatively low intensity, with its advantages wherever direct lighting is used. The question of color therapy, or the use of colored lights for the treatment of diseases, mental and physical, has attracted attention at various times. Quite a body of tradition has accumulated concerning the efficacy of certain colors, especially in the treatment of nervous affections. Space will not permit a discussion of the curative powers which colors are supposed to have; moreover, no scientific data concerning them are available. The use of colored spectacles, such as amber, rose and smoked glass, is mainly to reduce the intensity of the light, although special properties have at various times been attributed to certain colors. Here, too, experimental data are almost entirely lacking.

Momentary visual acuity seems to be highest for light which has approximately the composition of daylight.⁶ With colored lights the red end of the spectrum seems more favorable to acuity than the green, the values for the red ranging from 20 to 50 per cent above those for the green. The values for blue are quite similar to those for green, but somewhat lower. The fatigue test of Ferree and Rand shows much the same results as the simple acuity test. By using various light sources that are on the market, they were able to get

⁶D. E. Rice, *Ibid.*

a series of colored lights ranging from orange-yellow to blue-green. Their results in terms of per cent loss of efficiency, as described previously, and the time required for feelings of discomfort to appear are shown in Table XIII.⁷

TABLE XIII. FATIGUING EFFECTS OF LIGHTS OF DIFFERENT COLORS

	Per Cent Loss of Efficiency	Feelings of Discomfort Appeared After
		<i>seconds</i>
Unsaturated yellow	5.43	116
Reddish yellow—more saturated	7.57	94
Unsaturated yellow, with trace of red....	8.29	90
Orange-yellow	8.39	90
Unsaturated yellow, with trace of green..	8.48	90
Unsaturated yellow, with more green	24.00	48
Unsaturated yellowish-green	25.51	34
Unsaturated yellowish-green, with more green	33.14	25
Greenish	39.14	21
Bluish-green	54.86	14

Although white light is not represented in the table, it is reported to have a higher efficiency than any of the colors that were studied.

The character of the general illumination has taken an added importance for quite another reason than efficiency of vision. Certain properties of light are now known to have a very pronounced effect upon general health and especially upon the health of growing children. These properties are associated with the short light waves, just beyond the violet and known as ultra-violet rays. As ordinary glass used for

⁷ C. E. Ferree and G. Rand, "Some Experiments on the Eye with Different Illuminants, Part II," *Transactions of the Illuminating Engineering Society* (April 30, 1919), No. 3.

windows is opaque to these rays, the indoor daylight illumination is deprived of the beneficial properties of direct sunlight. The same is true of artificial illuminants, since they are usually transmitted through glass and whatever ultra-violet rays they contain would be filtered out. When the nature and value of these rays are better understood, the use of quartz glass and other media which are pervious to them will, doubtless, be employed so that both our natural and artificial illuminants will be healthful as well as efficient.

THE EFFECT OF MOTION PICTURES UPON VISUAL EFFICIENCY

The widespread popularity of motion pictures as means both of entertainment and of education raises the question as to their effects upon vision. If we examine the motion picture experience in relation to the important facts of vision described in the beginning of this chapter, we find that the distribution of light is uneven, and the great brilliance of the screen against the intense dark background gives strong contrasts. Both these conditions lead to eye fatigue. Furthermore, since the visual contrast phenomena are more pronounced in the peripheral parts of the visual field than in the center, the fatiguing effect should be greater if the spectator sits near enough to the screen to project the margin of the picture—where the contrast between light and dark is greatest—into this sensitive region. The flicker and unsteadiness of the picture, which were so prominent in the earlier pictures and have not been entirely eliminated from the best of the modern ones, are believed by most people to be the primary cause of eye discomfort. Ferree and Rand,⁸ who have investigated the matter, have analyzed the effect thus :

⁸ C. E. Ferree and G. Rand, "Further Experiments on the Efficiency of the Eye under Different Conditions of Lighting," *Transactions of Illuminating Engineering Society*, No. 6 (1915), pp. 491 f.

The eye is so constituted that when its images lose in clearness or distinctness it is incited to a muscular readjustment to bring about the clearness needed. Ordinarily in seeing, the conditions for loss in clearness come about primarily through the difference in the distance or direction from the eye of the objects which are successively viewed. In motion pictures, however, the changing clearness of the objects viewed is not due to any change in their distance or direction from the eye; nor to anything in fact which the readjustment of the eye can remedy to any considerable degree. The effort expended, therefore, is of little avail for seeing, if, indeed, the new setting of the parts is not a detriment to clear seeing and a condition which in turn must be corrected. This should, and doubtless does, lead to muscular strain and loss of efficiency.

The investigators just quoted measured the fatiguing effects of watching motion pictures for two hours, in a favorable environment and with the most approved type of motion-picture apparatus. The change in the ability to sustain clear seeing after the motion-picture experience as compared with before was the measure of fatigue. The results show a considerable loss of efficiency. When compared with the use of the eyes for other purposes, however, the loss does not seem excessive. For instance, it was found that it was somewhat less for one person than he experienced from three hours' reading from clear type printed on good paper under the direct or semi-indirect system of lighting. It has been inferred from the data taken from two subjects that the loss is just about as great as would result from an equal time spent in reading under usual conditions of artificial illumination. The distance from the screen had some influence upon the degree of fatigue. At a distance of 25 feet the loss was about 50 per cent, at a distance of 48 feet it was about 40 per cent, and at a distance of 71 feet it was about 30 per cent. Improvements in comfort and efficiency may be expected, therefore, from increases in steadiness of the picture, from providing a suitable minimum distance of

the observer from the screen and by increasing the general illumination of the room so as to break down the extreme contrasts of dark and light and reduce the necessity for rapid shifts in retinal sensitivity.

RESULTS OF ILLUMINATION SURVEYS

Surveys of business, industry, schools and the home in regard to the requirements of good illumination—as to distribution, intensity, and freedom from glare—show that conditions are far below the optimum. After recognition of the principles of good illumination, simple changes will frequently produce a great improvement. In industry, especially difficult problems are met, and government regulations are required to secure adequate working conditions. The New York State Industrial Code of Rules Relating to Lighting of Factories and Mercantile Establishments⁹ contains interesting minimum illumination requirements for nearly one hundred different operations. They range from 0.02-foot candles for roadways and yard thoroughfares to 5.0-foot candles for such fine work as engraving, drafting, watch-making, sewing, and jewel-setting. There are also specifications as to distribution, nature of shading, etc., which are in accord with the principles of good illumination. The Report of the Committee on Lighting in Factories (England)¹⁰ contains complaints of discomfort, eyestrain, and injury to the eyes of the workers from excessive glare, and recommends that “adequate and suitable lighting” be required by law. Adequate lighting is said to imply:

1. Sufficient light for the health, comfort and safety of the workers.

⁹ State of New York, Department of Labor Bulletin, No. 18.

¹⁰ For discussion of this and other similar material see H. M. Vernon, *Industrial Fatigue and Efficiency* (E. P. Dutton and Co., New York, 1921), pp. 227 f.; and M. Luckiesh, *Light and Work* (D. Van Nostrand Company, New York, 1924).

2. A reasonable constancy and uniformity of illumination over the area of the work.

3. Shading of light sources so that rays do not fall directly on the eyes of the operators.

4. The placing of lights so as to avoid disturbing shadows upon the work.

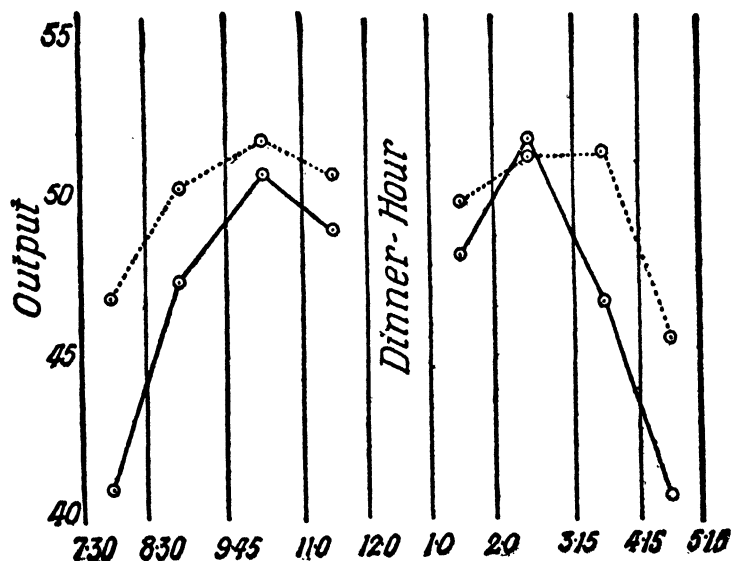


FIG. 17. THE INFLUENCE OF POOR ILLUMINATION UPON OUTPUT

In Germany attention has long been paid to correct factory lighting. Where investigations have been made under controlled conditions output has been found to increase much more rapidly than the cost of the improved lighting. For example, in a series of experiments conducted by the Commonwealth Edison Company of Chicago it was found that greatly improved lighting increased output in several operations as much as 8 to 27 per cent. The average increase was 15 per cent, while the average cost of the improvements

amounted to only 5 per cent of the pay roll for the period. These figures are reported to represent a conservative sampling of the data available on this question. Figure 17 will serve as an illustration of the many field studies of illumination in industry made by the Industrial Fatigue Research Board (England).¹¹ It gives a graphic illustration of the effects of poor artificial illumination as compared with ordinary daylight illumination. The only known difference in the conditions determining the output represented by the dotted and the solid curve is the fact that the solid curve includes days on which artificial illumination had to be used during the first hour of the day and the last hour of the day, while on the days represented by the dotted line no artificial illumination had to be used. Each curve represents the output per hour as indicated along the base line. Not only is the output lower in the first hour of the mornings when artificial illumination was used, but it remains considerably lower during every hour of the day except one. It would seem that any ill effects that were suffered during this first hour were serious enough to disturb the performance of the workers during the rest of the day. This is, doubtless, an extreme case since the work studied was silk weaving and the type of illumination was such as to leave exposed to the eye unshaded incandescent bulbs hanging at about the level of the eyes. Such conditions violate all the laws of good illumination.

¹¹ Report No. 9, 1920. See also No. 20, No. 23.

CHAPTER XII

THE EFFECTS OF DISTRACTION

DISTRACTION should be thought of as a form of attention. In every waking moment something is being attended to. And at every moment there is a great variety of objects competing for our attention. These are facts resting upon the nature of the inherited sensory and motor mechanisms. It is equally natural that only one of these objects or a limited group of them should be attended to at one time and that attention should tend to shift from one of them to another. The objects which can be attended to are of the most varied sort. They may be objects that are experienced only by way of the distance receptors, the eye, the ear and the nose, the sights, sounds and odors of everyday life; or they may be objects in contact with the body, thus affecting the contact receptors in the mouth, skin, the muscles and internal organs, bringing tastes, feelings of warmth and cold, contact of clothing, etc., pains, sense of movement, and fatigue; or they may be memories, or products of the imagination.

Attention, by its derivation, means "to be drawn to" or "to be attracted to." Out of all the complex of objects exerting their attracting power, one or a few of them will be the most effective and will be attended to. All the others then become distracters of the attention, in that they tend to draw the attention toward themselves. Thus, what is at one moment the object of attention, may at another be a distracter. There is, therefore, no real difference between "attractors" and "distracters." The distinction usually

made is a kind of utilitarian one, namely, that those objects that attract attention when one wants or ought to be attending to something else are distracters. For example, when I ought to be studying, my neighbor's good music is a distraction. When I want to read, the bright light on the wall is a distraction. But both the music and the light may cease to distract me and begin to attract me when I intend to pay attention to them. When at work at a rapidly moving and dangerous cutting machine, I may be distracted by memories of a foolish mistake of the evening before, or by the imagination of myself speeding over country roads in an automobile that I can never afford to purchase. A kind of moral distinction is also sometimes made between what I want to attend to and what I ought to attend to. The former are distracters and the latter attractors. It is not always safe, therefore, to think of distracters as unpleasant or undesirable from the point of view of the individual affected. Although it is necessary to understand these essential characteristics of distractions, it will suffice for the present to list as distracters only those objects, feelings, memories and ideas which tend to interfere with work.

This struggle for attention implies more than a mere subjective conflict. Attention is inseparably bound up with adjusting movements and tensions which involve not only the muscles regulating the sense organs, but also the voluntary musculature, as indicated by respiratory, circulatory and other organic reactions. Such muscular responses consume energy and lead to strain and fatigue just like any other kind of muscular work. In fact, the conflict between antagonistic muscle groups is especially likely to lead to such effects, because the parts are under a constant tension, even when no overt movement occurs. For example, if a flickering light source lies within the field of vision while one is reading, one set of muscles tends to turn the eyes toward the light and another tends to draw them in the

opposite direction. In such a case the eyes may remain adjusted to the book, but the muscles will be under constant tension. Accurate measurement might, in this case, show an unsteadiness of the eyes due to the fluctuations in the success of the conflict. Tensions in other voluntary muscles are usually present and seem to give aid in directing the attention. Although evidence of such conflict is particularly clear in the case of vision, it is, nevertheless, present in attention to any class of stimuli.

If the average person were to be asked whether or not distractions of any sort are advantageous, his reply would most likely be that they are not, for the term distraction implies an interference or disturbance. Evidence could be adduced of the disturbing effects upon efficient work of an aching corn, an itching nose, an ill-fitting collar, a broken finger nail, the hum of conversation or the rattle of a typewriter. Still, there is the opposite view popularly expressed in the saying that "a dog without fleas would die," and the testimony of persons who seem either entirely unaffected or even benefited by a limited amount of distraction. At the present time when a search is being made for causes of inefficiency, and when business offices are filled with clicking typewriters, when industrial plants are resounding with the noise of huge machines, and the streets are filled with the sounds of traffic, the question of the real effect of distractions is worthy of careful study. Whether the distractions be great or small, the problem remains the same, namely, are distractions harmful and if so, why?

ADJUSTMENT OF EFFORT TO TASK

Little aid has been given by experimental studies of distraction and its effects, which tend to minimize the influence of most kinds of distraction. This conclusion has been reached by measurements of work done under conditions that

are distracting in comparison with what is done under conditions that are free from distraction. A peculiar difficulty is encountered in the interpretation of these studies. It is a matter of common knowledge that when conditions are made more difficult, an individual will usually rise to the occasion and overcome the difficulty. Experimental evidence supports this belief. One practically never exerts himself to the limit, either mentally or physically, so that there is a reserve supply of energy which may be drawn upon to overcome obstacles.¹ The use of such reserves is responsible for the effect of incentives to action, whether it be memorizing a poem or acquiring an act of skill. Now it happens that disturbances in one's environment may act as a stimulus or incentive to greater effort in order to overcome them, and hence give the impression of increased efficiency.

The tendency to adjust behavior to the size of the task is one of the most interesting of psychological phenomena. A very simple case of it occurs in the size-weight illusion, in which the relative weight of two objects is estimated. One of these objects is large and the other small, but they are of exactly the same weight and similar in appearance. When lifted one at a time in the hand, the large one seems light and the small one seems heavy. It is not uncommon to have persons report that the small one is four times as heavy as the large one. There is an involuntary adjustment of the effort to the *expected* weight, with the result that the small one is lifted with relative difficulty and the large one with relative ease. In learning, similar adjustments are found to occur, where it sometimes happens that a large task is learned better than a small one, because the small one is taken too lightly or the large one is taken too

¹ See W. James, *On Vital Reserves* (Henry Holt and Company, New York, 1911).

seriously. These may be thought of as cases of over- and under-adjustment.

An adjustment of a somewhat different sort occurs in certain physical work experiments. For instance, if a person is instructed to squeeze a hand dynamometer once with all his force, he will do a certain amount of physical work. If, however, he is required to make fifteen consecutive con-

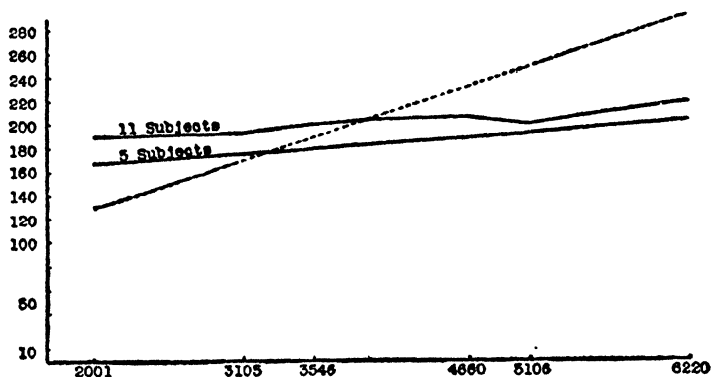


FIG. 18. CHANGES IN RATE OF LIFTING WITH INCREASE OF LOAD

tractions with all his force, the first contraction will produce less work than when only one contraction is called for. The data from seven subjects in an experiment of this sort² show that when one contraction is required, there is an average of 68 kilograms of pressure exerted, but when fifteen are called for there is an average of only 52 kilograms. Since the persons did their "best" in both cases, the difference is the result of an involuntary adjustment to the size of the task. The most striking evidence of such adjustments is to be found in the distraction experiments of Morgan.³ The task consisted in exerting the "maximum

² A. T. Poffenberger (*unpublished*).

³ J. J. B. Morgan, "The Overcoming of Distraction and Other Resistances," *Archives of Psychology*, No. 35 (1916).

effort" possible in lifting a weight which varied from 2,000 to about 6,000 grams. (Approximately 4 to 13 pounds.) The time required for lifting should increase at a known rate as the weight increases if the effort exerted remains the same. The dotted line in Figure 18 shows this increase in time that should have occurred with the different weights, while the solid line shows the changes in time that actually occurred. The horizontal scale indicates the weights and the vertical scale shows the lifting time in thousandths of a second. It appears, then, that the lifting time tended to remain constant, so that the effort exerted must have been adjusted to the size of the load, so as to keep the time fairly constant. An increase of 300 per cent in the load produced a decrease in output of only about 16 per cent.

The tendency to adopt a certain rate of work regardless of the magnitude of the task is called by Morgan the "congenial pace." It varies for different people, but all show the adjustment to some degree. Some tend to set a pace that is too rapid for their strength, while others adjust themselves far below their powers. The adjustment process was especially clear where the weight was gradually decreased. In several cases the decrease in force exerted was so considerable that when the weight was changed unexpectedly from 2,000 to 6,000 grams the force being used was not sufficient to move the weight at all. An interesting type of adjustment is described as follows:

Subject Si, in his very first pull, made a score with the weight 6,220 grams of 100 sigma.⁴ He threw himself into it with all his might. When it came up so quickly, he expressed his surprise that the weight was no heavier, and his next trial was 371 sigma. He was then told to do his best and pull all the time as hard as he did in the first trial, but either he could not or would not, for his times ranged from 206 to 261 sigma. This again

⁴ Sigma is the symbol for 1/1000th second.

goes to show that a subject expends energy in proportion to the idea he has of the difficulty of the task.

Such evidence as this makes it obvious that the effects of distraction cannot be measured with safety in terms of output of work if one is really interested in the efficiency of the operation. Where there is a falling off in output upon the introduction of "disturbances," the findings should be taken as evidence of a falling efficiency. Adjustments cannot entirely overcome the resistance in every case, so that a residue of effect will sometimes manifest itself. In the curves of Figure 18, there is not a 100-per-cent adjustment of effort to increase in weight, although if one estimated the load in terms of the time required to lift he would make a very serious error, indeed. Furthermore, the adjustment is not always immediate, and under some circumstances may develop rather slowly. This is clearly demonstrated in the adaptation to changes in industrial working conditions, where an adequate adjustment may require as much as five or six months. (See Chapter XIX.) The average person judges the effects of distractions in terms of discomfort and feelings of effort and fatigue. The shortcomings of these indicators have been discussed in their relation to fatigue. They are no more reliable as practical measures of the effects of distractions.

What should be the ultimate measure of the cost of distractions? The fundamental problem is one of energy and its conservation. A distracting noise that one apparently disregards by an added effort so as to keep up a normal flow of work is still detrimental, because it is using additional energy. The ideal measure of distraction would be one directly in terms of energy consumed. Such measures have not been possible up to the present except under the most elaborate experimental conditions. It is possible, however, to approach the problem in a somewhat different fashion.

If overcoming distractions means using additional energy, how is this energy used? The extra work must consist either in the activity of mechanisms tending to inhibit the response to distraction, or in the increased activity of other mechanisms. The latter manner of consuming energy may be detected by looking for accessory muscular movements set up in the presence of the distraction.

THE DISTRACTING EFFECT OF NOISE

The influence of distractions has been most frequently measured upon very short and simple operations, such as judgment of lines and weights, the accuracy of movement, and reaction time.⁵ For example, how will the speed with which the finger can be lifted from a key upon the receipt of a specified stimulus be affected by the introduction of extraneous sounds, lights, bodily contacts, electric shocks and the like? The results of such studies are in accord with our previous discussion. The speed of reaction at first becomes slower, when the disturbance is introduced. This initial slowing up is followed by a gradual adaptation to the new conditions, although the slowing effect of the disturbance is never entirely overcome. If the reaction times are plotted, they form a curve very much like the simple practice curve, in which the adaptation is most rapid at first and becomes slower and slower until no further improvement occurs. These studies show, too, that stimuli differ in their disturbing power, although no very wide range of quality and intensity has been employed. In general, it appears that disturbances which affect the sense organs that are primarily involved in the work, are more disturbing than those which affect the "inactive" sense organs.

⁵ For a survey of such experimental work see J. E. Evans, "The Effects of Distraction upon Reaction Time," *Archives of Psychology*, No. 37 (1916).

Thus, if one is reacting to sounds, extraneous sounds are the most bothersome, while if one is reacting to lights, extraneous lights are most disturbing. In none of the experiments of this type has there been any measurement other than output, so that the real efficiency of the process cannot be determined.

The distraction studies of Morgan, mentioned above, are of particular interest for several reasons. He studied the effects of noises upon work requiring a high degree of attention and little susceptible to improvement from practice and carried his tests over a fairly long period of time. Moreover, he attempted to measure the economy of the work as well as mere output. His findings are applicable, therefore, to experience with disturbances in everyday life. The work performed by his subjects consisted of a kind of translation of letters into numbers or numbers into letters by way of a code, which varied in complexity in different sections of the experiment. Output was measured in terms of the time required for translating a given number of units of work, and the accuracy of the translations. Effort was measured in terms of the character of the breathing, the rate of breathing, and the amount of pressure exerted upon the keys which were struck in recording the translations. Additional measures were attempted but were found too difficult to control under the circumstances. The noises came from a great variety of electric bells and buzzers, the largest being an eight-inch fire gong. A series of six phonograph records was also used at times.

Figure 19 gives a graphic picture of the effects of the noises, from which a number of important facts may be noted. The vertical scale indicates seconds of time required for a unit of work, while the horizontal sections indicate the alternately quiet and noisy periods. In the quiet period is shown the speed of the last 40 reactions, in sets of 10, immediately before the noise is introduced, and in the

noise periods is shown the speed of the first 40 reactions immediately after the noise is introduced. The records of only four subjects are given as samples. In the case of every person, the introduction of the noise slows the translating time. Recovery from this is rapid, however, so that the speed soon equals that of the quiet period. In three of the four cases shown, the speed at the end of the noise period is greater than at the end of the preceding quiet period.

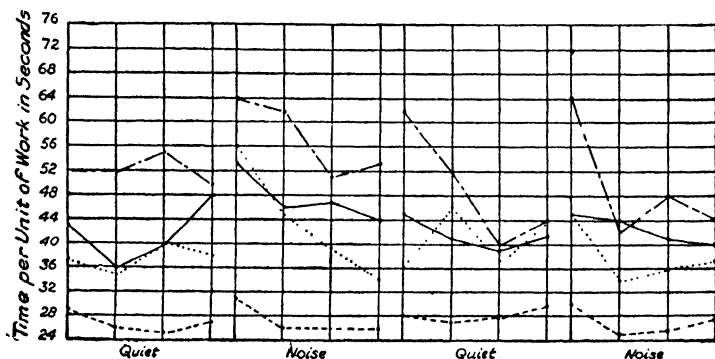


FIG. 19. THE EFFECT OF NOISE UPON OUTPUT

When the second quiet period begins, that is, after the noise has ceased, the speed of two of the subjects is decreased, showing that the shift from noise to quiet is disturbing for a few moments for some persons. When noise is introduced the second time, the disturbance is again evident and the recovery rapid. Three of the four cases again show a faster speed at the end of the noise period than at the end of the preceding quiet period. The records of errors made show no inferior grade of work during the noise and are too few to have any significance.

Concerning the results from eight persons subjected to this experiment, four of whom are charted in Figure 19, the author says:

At first thought it may seem to follow that a noisy condition is more favorable than a quiet one. If six out of the eight make a better time during noise than before the noises were introduced, and if six out of eight make slower time after the noises stop, might it not follow that noises have a dynamogenic effect, spurring the subject to increased activity? This might be a legitimate conclusion were it not for the initial retardation at the beginning of the noise periods. If the influence were one of simple dynamogenesis, it does not seem plausible that the first effect should be one of interference. If a motor is going at a certain speed and more current is turned on, it does not first stop or slow down and then take on speed and exceed its former motion, unless the direction of the increased current is reversed.

It is not, therefore, a legitimate interpretation of the data to ignore the slowing effect or pass over it lightly and say that in general the effect of noise is a stimulation; just as it would not be a proper treatment of the data to average the whole period together and conclude that the noise had no effect.

After giving each feature of the results due weight we do not conclude that a noisy condition is just as conducive to good work as a quiet one. Our work thus far has simply served to show that noises have *some* effect upon work, and that the effect is a complex one.

The production curves should now be checked against the energy expenditure curves in order to see whether the adjustment to the noise conditions involves additional cost. For this purpose the production records of all subjects are averaged and these with all the energy measures, breathing quality and rate, and key pressure are reduced to a common standard. The data thus combined for all but the breathing rate are shown in Figure 20. The vertical scale represents the common standard for all measures and ranges from zero to 12. Along the base line are shown in succession three quiet periods, seven noise periods and two quiet periods. The noise periods represent the combination of bells and buzzers and the six phonograph records in the order in which they were presented.

The time record shows a disturbance at the beginning

of the noise period with a gradual adaptation and improvement in speed during the series of disturbances. The key pressure records, on the other hand, show that greater effort was exerted throughout the noise period than in either the first or second quiet period, with the greatest effort at the beginning of the noise period. The tension is greater with the harsh noises than with the phonograph records. The breathing curve gives evidence only of the degree to which the breathing is disturbed through articulation, and shows,

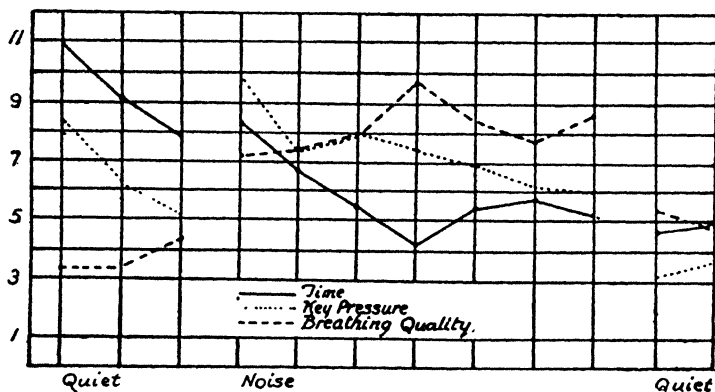


FIG. 20. EFFECTS OF NOISE MEASURED IN TERMS OF EFFORT

therefore, the extent to which this aid to attention had to be used to resist the noise distractions. The rising curve shows that most of the persons did not discover the value of this aid at once, but hit upon it gradually. The curve reaches its maximum in the middle of the noise period. When the quiet period follows the noise period, the key pressure is reduced and the breathing shows absence of articulation. "These records taken together show that at the first intrusion of the disturbances the subject is confused (see time record), he is somewhat excited by the disturbance (breathing rate), and strains to overcome it (key pressure record).

The attempt to overcome it in most subjects leads to articulation, which in the majority of cases is not struck upon as an aid at once. With the help of this strain and articulation, the time effect of the noises disappears and the subject attains or even exceeds his former speed."

OTHER DISTRACTING INFLUENCES

In addition to noises, two other sources of distraction have been rather extensively dealt with in business and industry, namely, visual distractions arising from defects in the system of illumination, and from the presence of polished surfaces of desks, machines, etc., which reflect light; and ventilation distractions arising from the discomfort of hot, cold and humid atmospheric conditions. In so far as the effects of poor lighting are not limited to eyestrain and its consequences from conditions unsuitable for the needed acuity of vision, they are probably the effects of the distracting power of poorly distributed lights. And in so far as ventilation conditions do not produce a direct organic effect showing itself in loss of appetite and weakened physical condition, they also are reducible to the distracting influence of bodily discomfort. These matters have been discussed in the two preceding chapters and their influence demonstrated by laboratory and field studies. It seems scarcely worth while to attempt to catalogue other distractions, in the light of our analysis of distraction at the beginning of this chapter. They are so much a product of the interaction of the individual and his working conditions, rather than a characteristic of the objective situation, that a distraction in one set of circumstances turns out not to be a distraction in another set of circumstances.

The practical rule would seem to be, from this survey of distraction, that, where work of high quality or in large quantity is to be done, the environment should be as free as possible from distractions of all sorts. In certain industries

where efficiency methods have been introduced, not only such simple distractions as lights and sounds, uncomfortable and ill-suited clothing have been eliminated, but more complex mental distractions such as fear of accident have been removed by safety appliances, fear of sickness by introduction of methods of sanitation, fear of leaving dependents unprovided for by the introduction of insurance schemes. If the reports are to be accepted, efficiency is increased by these means. The rule will apply not only to highly organized industries, but the individual may find means of eliminating from his environment many apparently slight distractions, which in the course of weeks or months would make a considerable drain upon his energy:

MONOTONY AND ITS EFFECTS

Monotony offers one of the most puzzling problems that the applied psychologist has to face. Not only is there great difference of opinion as to what causes it, but there is much confusion also as to what it really is. Upon one matter there seems to be general agreement, namely, that the modern organization of business and industry has heightened the monotony of work. Just what it is in modern methods which is responsible is a matter of controversy. According to one point of view, it is attributed to the fact that the heavy manual operations are now done by machinery, leaving to the worker only such manual operations as involve light and dexterous work, so that the mental effects are becoming relatively more important than the bodily effects. According to another, it is due to the complete separation of the manual worker from the brain worker, with the result that the latter appropriates all the interest that is wrapped up in industry and leaves nothing to the worker but monotonous toil. According to still another view, it is the result of repetition of a highly specialized set of operations, and it makes no difference whether these are manual or mental.

Finally, monotony is looked upon as a purely subjective condition and not as a characteristic of the work at all. It depends upon the nature of the individual and need have no relation to repetitive work, or the limitation of the task to either mental or physical operations.⁶

Each of these points of view emphasizes a real and important aspect of monotony: it is sometimes present in routine mental work and sometimes in routine manual work; a task such as a game of bridge may be monotonous although repetition and routine are at a minimum; and it is certainly true that the same game of bridge that is monotonous to one person will be stimulating to another. Unless the concept of monotony is merely a class name under which are subsumed a whole collection of miscellaneous and little related phenomena, its underlying cause must be sought in some fundamental characteristics of behavior. It seems possible, without creating any distinctly new theory of monotony, to relate it to the phenomena of distraction.

We have said that a waking person is always attending to something and that there is a natural tendency for attention to fluctuate or flit about from one object to another. Whether this phenomenon of fluctuation is due to temporary blocking of the conducting mechanisms within the central nervous system, or whether it is evidence of a kind of refractory phase of parts of the central nervous system analogous to that in heart action and parts of the spinal cord, is not known. It is tiring or fatiguing to resist this tendency to fluctuate. It implies an inhibitory process which is not a purely subjective phenomenon, but is a struggle between motor mechanisms for the control and direction of behavior.

⁶ For a discussion of the various interpretations of monotony see H. Münsterberg, *Psychology and Industrial Efficiency* (Houghton Mifflin Co., Boston, 1913), Chap. 16; F. Watts, *An Introduction to the Psychological Problems of Industry* (George Allen and Unwin, Ltd., London, 1921), Chap. 5; and C. S. Myers, *Lectures on Industrial Administration* (London, 1920, edited by B. Muscio).

When the movements of attention are artificially restricted by the devices of the hypnotist, the patient will fall asleep. When not under such artificial control, constant attention of a limited sort is boring, wearisome, monotonous. Innumerable objects are competing for the attention. Some of them we call distractions if, for any reason, they are not appropriate objects of attention. We have shown already that resistance to such distractions, whether they are lights, sounds, odors, contacts or what not, means the expenditure of effort.

The competition for attention which occurs under ordinary circumstances is between what one *wants* to attend to and what he *needs* to attend to. The wants must be inhibited in favor of the needs. To maintain attention upon a routine task when the mind is drawn toward pleasing objects, memories and imaginations means the expenditure of effort and is fatiguing. Where the need is great, as in tending a rapidly revolving and dangerous machine so that fluctuations of attention might mean an accident, the inhibition of the distractions soon becomes wearisome. The task has become monotonous. On the other hand, where needs and desires coincide exactly, monotony should be entirely absent. According to this interpretation, resisting the distraction of a bright light when reading should give the same sort of irritation, restlessness and weariness that results from resisting pleasing memories or other powerful competitors for attention while working. Such seems to be the case. Monotony might, therefore, be called a manifestation of fatigue of the attention mechanism which results from resisting a particular class of distractions.

INDIVIDUAL DIFFERENCES IN SUSCEPTIBILITY TO MONOTONY

Individual differences in susceptibility to monotony should be expected just as in the resistance to distractions. What is a distraction for one person becomes an object of inter-

est for another, and what is monotonous for one may not be so for another. Besides the differences in susceptibility to monotony from a given situation which result from differences in interest, there is believed to be a more fundamental difference among people in this respect. Münsterberg, for instance, who posited such differences accounted for them by the characteristics of the psychophysical organism. There are some persons, he said, for whom the receipt of a certain stimulus sharpens the attention for a repetition of that stimulus, while there are others for whom the receipt of such a stimulus dulls or inhibits the attention for a repetition of it. The former would tend not to experience monotony while the latter would. While this particular formulation is still a matter of theory, Münsterberg found some support for it in his laboratory experiments. There are certain well-recognized differences among people that may have a bearing on their susceptibility to monotony, namely, the ease or difficulty of shifting from one thing to another. Some persons, when once they are "set" in a certain course, are hard to shake out of it, while others are notorious in their shifting of interests. Whatever the cause of these differences in attitude toward work may be, the differences themselves have frequently been reported by observers of industrial work. Münsterberg⁷ cites a case, which will appear to the reader as an extremely monotonous activity, in which a worker packed incandescent lamps in tissue paper. She wrapped them from morning to night, from the first day of the year to the last, and had been doing that for the previous 12 years. She performed this packing process at an average rate of 13,000 lamps a day. The woman had reached about 50,000,000 times for the next lamp with one hand and with the other to the little pile of tissue sheets and then performed the packing. Each lamp demanded about 20 finger

⁷ H. Münsterberg, *Psychology and Industrial Efficiency* (Houghton Mifflin Co., Boston), p. 197.

movements. She was able to pack 25 lamps in 42 seconds and seldom did she need as many as 44 seconds. Every 25 lamps filled a box, and the closing of the box required a short time for itself. She evidently took pleasure in expressing herself fully about her occupation. She found the work really interesting, and constantly felt an inner tension, thinking how many boxes she would be able to fill before the next pause. Above all, she experienced a sense of variety in her work. Sometimes she grasped the lamp or paper in a different way, sometimes the packing itself did not run smoothly, sometimes she felt fresher, sometimes less in the mood for the work, and always found something to observe and something to think about.

THE ELIMINATION OF MONOTONY

If such differences in susceptibility to monotony among people are genuine and are eventually discoverable by tests, the most effective remedy for monotony will be the proper adjustment of every individual to the type of work for which he is adapted. Such adjustment would, of course, not eliminate all monotony, for some would still arise from the temporary fluctuations of interest. Then, too, it is conceivable that there would be more so-called monotonous jobs than there would be people immune from monotony to fill them. Finally, it must be remembered that, even if such different types of individuals are found to exist, it may be, as one investigator believes, that months or years of monotonous work may have warped some people so as to enable them to endure monotony, that is, they may be the products of our industrial methods. Properly devised and administered tests for susceptibility to routine tasks would settle the question of the origin of these types. There are indications in the results of research work that there may be a negative relationship between intelligence and immunity from monotony. It seems to be definitely established that low-grade

mentalities find satisfaction in jobs of a highly repetitive character, and that these same persons are worried and oppressed by more complicated tasks. This material will not be reviewed here, as it can be presented more appropriately in our consideration of satisfaction from work. (See Chapter XX.)

The monotony that cannot be avoided by the proper selection of workers may be removed, at least in part, by the proper arrangement of work and rest schedules, and the introduction of variety into work. The former has been extensively adopted and improvement in efficiency is almost invariably reported. How much of the improvement is due to the reduction of monotony cannot be estimated, however, as the change of work schedules involves a modification of the work in so many different respects. The introduction of variety into industrial work, although frequently discussed, has been rarely tried. Aside from the difficulty of administration, such a program will meet resistance as it looks like a return to the pre-standardization era in industry. Such evidence as there is points to an increased output from change of work together with a decrease in the feelings of monotony.

In a laboratory investigation of this question, three persons performed three types of work with two forms of daily work schedule. The tasks were simple mental addition, addition by means of a comptometer, and a simple form of muscular work. The daily schedules which were followed for six weeks consisted of two 2½-hour work spells separated by one hour for lunch. On some days the whole five hours were spent on one kind of work, while on others work was changed every 50 minutes. In every case the variegated schedule gave both a greater output and a higher degree of accuracy, as shown in Table XIV. Introspective reports from the subjects show that the unvaried work days were very monotonous and boresome and that the varied work

TABLE XIV. EFFECTS OF CHANGE OF OCCUPATION IN SIMPLE MENTAL AND MOTOR WORK

	SUBJECT	PER CENT INCREASE ON VARIED DAYS	
		Output	Accuracy
Adding	A	24.2	26.1
	B	8.8	55.1
	C	10.6	25.1
Comptometer	A	12.7	43.4
	B	4.2	9.2
	C	18.2	27.9
Muscular	A	7.8	...
	B	2.4	...
	C	5.1	...

days were far more satisfactory and enjoyable. Interesting comparisons were made between output records and introspective reports for the different subjects. Subject A, who made the greatest improvement from the introduction of variety, found the continued repetition of the work most tedious and monotonous. "This subject is much more unstable temperamentally than either B or C, and it would be interesting to determine the relation between such temperaments and the dislike for repetitive work. It may be found that the individuals who find repetitive work most monotonous are not only those with a high degree of intelligence, but also those who possess the organic and nervous peculiarities which give rise to sensitive and unstable temperaments. Subject A would probably find repetition work in industry too exacting and tedious, while subject B would be suitable for work of a rhythmic nature."⁸

These results are confirmed by a field study (by the same investigator) of output in the packing of drugs in a whole-

⁸ S. Wyatt, *The Effect of Changes in Activity* (Industrial Fatigue Research Board, London, 1924), Report No. 26.

TABLE XV. EFFECTS OF CHANGE OF OCCUPATION IN PACKING DRUGS

	EARNINGS PER DAY	
	Percentages of Lowest Score	
	<i>Subject A</i>	<i>Subject B</i>
No change	114.8	135.6
Few changes	117.3	120.3
Many changes	100.0	100.9

sale firm, in which two workers were observed over a period of several days. Three schedules were followed. The first, in which there were many changes, consisted in adjusting the work to the character of the small orders for drugs as they were received. Not only was there a variation in the commodity to be packed, but each operator gathered the drugs, packing material, counted, packed and wrapped each order separately. The second, in which there were few changes, involved a shift of occupation every half hour throughout the day. In the third schedule, the same work was done throughout the day. The relative efficiency of these schedules in terms of output is shown in Table XV, in which the records are in terms of the per cent of the lowest daily wage earned. This lowest daily wage was earned by Subject A in the day of many changes, which is given, therefore, a score of 100. It appears that few changes are better than many changes and that for one subject at least no change is still better as far as output is concerned. Naturally, some of the increased output is due to the reduction in "unproductive" time spent in changing from one process to another. On the days of many changes, this "unproductive" time amounted to about 20 per cent of the day. Some of the increase is due also to speeding up of the work process through getting into the "swing" of it. On the days when no changes were

made, of course, the unproductive time was almost entirely eliminated. The speed of the work fell off sharply during the day, so that during the last two hours of work a unit of work required 19 per cent longer than during the first two hours. During these unvaried days the operators "often showed signs of discomfort, especially during the latter part of the afternoon spell. They appeared to be physically uncomfortable and frequently changed their posture." Checking the work curves against the introspective reports of the workers, and the observations of the investigator, led to the conclusion that unvarying repetitive work throughout the day was "conducive to fatigue, boredom and monotony, and is disliked by the operatives. Although it enables the work to be done at times with greater rapidity and dexterity, the cumulative effects of fatigue and monotony almost neutralize these advantages."

It appears from these two studies, as well as from a more theoretical consideration of the problems of monotony, that an optimum condition exists somewhere between unvaried and frequently varied work. The loss of time from too frequent shifting must be avoided as well as the loss from weariness when no changes are permitted. The schedule of changes will vary with the type of work, such as the time required to complete one unit of work, whether the operations are slow or rapid, the amount of concentration of attention needed, etc. A detailed study of the form of the daily work curve will be necessary to plan the optimum schedule.

CHAPTER XIII

THE INFLUENCE OF DRUGS AND STIMULANTS

No treatment concerning the regulation of human behavior would be complete without reference to the mass of data and opinion upon the effects of drugs and stimulants. The great publicity given to the marketing of coffee substitutes with emphasis upon the harmful effects of coffee, the attack by the Federal Government upon certain soft drinks containing small amounts of drugs, the threatened attack upon the sale and use of tobacco, and above all the introduction of nation-wide prohibition, have given the question of the effects of these substances a prominent place in the minds of all people. Great confusion has resulted from the dissemination of misleading statistical information, so that at present the people at large have no satisfactory basis for the formation of an opinion. Partisanship of one sort or another has always been back of the propaganda upon which such opinions rest. What is most needed to-day is an unbiased evaluation of the existing data relating to the effects of these different substances when taken in small or large quantities and over different lengths of time, and the prosecution of more elaborate and intensive investigations for the accumulation of further information.

SOURCES OF ERROR IN DRUG INVESTIGATIONS

The real effects of drugs and stimulants upon human activity must be determined from the most careful and scientific procedure as opposed to the unchecked opinion and

prejudice which are responsible for the common popular impressions. There is no field of psychological investigation more difficult and involved than this one of the effects of drugs and stimulants. The difficulties of experimental procedure are due largely to the suggestibility of people who have a knowledge of the effects to be expected. Much of the experimental work has failed to eliminate the possibility of suggestion and the results are questionable on that account. A further source of error in many tests has been the lack of control subjects, or persons who are treated in every way identical with the others, except that the drug or stimulant in question is not administered to them. Control groups serve as a check against interpreting as drug effects results which are due to other factors, affecting both groups alike. The first difficulty, that of suggestibility, can be avoided only by preventing persons from knowing what drugs they are taking, and when they are taking them. The drugs must be disguised, usually by having them placed in a neutral substance of some kind, which may be given regularly, sometimes containing the drug and sometimes not. In some cases the fulfillment of these conditions is extremely difficult and in others practically impossible.

There is a further serious difficulty in this type of investigation, which, however, is not limited to drug experiments exclusively, namely, the measurement of the effect. Shall it be measured in terms of work done, an objective measure, or shall it be measured in terms of feelings, a purely subjective measure? Both indicators seem partially inadequate in this work. The effects of a drug are likely to consist in an increased difficulty of a given task, a greater inertia which must be overcome. But it can be overcome by increased effort, hence the objective measure may remain unchanged. In such a case it might appear that the feelings of effort would be a more accurate measure than the objective record, except for the known unreliability of the subjective criteria

of efficiency. A study recently made by Hollingworth¹ demonstrates the variability of different measures of drug effects. He measured the effects of alcohol when taken in small and large doses, by means of the introspective reports of the persons taking it, the reports of observers, and the records of performance in a series of motor and mental tests. He concludes: "It seems clear, then, that effects may be present which are measurable by properly chosen technique long before they are manifested in the individual's gross conduct in a normal, social, working situation, and even a considerable time before they are indicated by the subjectively reported symptoms." In order that all these measures shall agree, the doses of alcohol must be very large and be consumed within one hour. Consequently, a third measure has been suggested, a direct measure of the energy consumed in work under drug conditions as compared with normal conditions. The measurement of energy consumption has been such an elaborate and technical task until recently that it was practically impossible to apply it under ordinary test conditions. The improvement and simplification of methods for measuring energy² open a wide range of possibilities for the better understanding of drug effects. Most of the experiments upon which our discussions are based have used objective records of one kind or another to determine drug effects, emphasis being placed where possible upon the selection of forms of behavior for measurement which are partially independent of voluntary control.

One further difficulty may be mentioned, namely, that the experiments devised for testing the effects of drugs and stimulants are quite short compared with the long periods over which they may be used in actual practice. Conse-

¹ H. L. Hollingworth, "When Is a Man Intoxicated?" *Journal of Applied Psychology*, Vol. IX (1925), pp. 122 ff.

² For information concerning the practical application of these methods, see pp. 372 ff.

quently, conclusions from such experiments should be limited to the circumstances under which the tests were made and should not be made to cover cases of long continued use. This error is not peculiar to psychological tests alone. The same criticism, for instance, may be lodged against the tests of the physiological effects of benzoate of soda and other similar preservatives which establish them as harmless when taken in extremely small quantities. Has the possibility of cumulative effect from long continued use been sufficiently taken into account? *

Our discussion will deal mainly with the effect of the more common drugs and stimulants, such as are real factors in the problem of personal efficiency. They will be considered in the following three groups: (1) tobacco, especially when smoked, (2) alcohol, in the various forms in which it is commonly taken, (3) caffeine, which is the drug appearing in coffee, tea and some soda-fountain drinks.

THE EFFECTS OF TOBACCO

Statistical studies of the influence of tobacco smoking, such as the number of inmates of penal institutions who use tobacco, and the influence of tobacco on growth as determined by the relative number of tall and short persons who used tobacco during the growth period, are complex to say the least. The humorous remark that a "drop of nicotine on the tongue of a cat will kill the strongest man," illustrates fairly well the character of the data usually brought to bear on the question.

From the experimental point of view the investigation of tobacco, and especially smoking, the most common form in which it is used, is subject to all of the difficulties men-

*An excellent statement of the sources of error that are met in drug investigations, and a demonstration of the technique which their elimination requires, will be found in H. L. Hollingworth, "The Influence of Caffeine on Efficiency," *Archives of Psychology*, No. 22 (1912).

tioned above as peculiar to drug problems. Especially important and almost impossible to eliminate is the factor of suggestion. And in all cases the experiments fall short of actual conditions in that they cover relatively brief periods of time. Most of the experiments report the effects following immediately after smoking, the indulgence being limited usually to one cigar, cigarette or the like.

Tobacco is commonly said to reduce efficiency by introducing a poison into the system, and this poison is generally believed to be nicotine. Consequently, nicotine has been given in experimental doses and the effects produced are interpreted as indicative of the effects of tobacco smoking. The proportion of nicotine carried in smoke ranges, according to different authorities, from 7 to 70 per cent of that contained in the tobacco. As a matter of fact chemical analyses⁴ tend to show that it is exceptional to find any nicotine at all in tobacco smoke. (It does occur in small quantities in the smoke of rapidly burning cigarettes.) The nicotine in the burning is decomposed into pyradine and other substances. It may seem to make little difference whether the toxic factor be called nicotine or pyradine, except for the fact that pyradine is only about one-twentieth as poisonous as nicotine. The physiological effects of nicotine introduced into the body through smoking are said to be moderate constriction of blood vessels, rise in blood pressure during the smoking period with a rapid fall immediately afterward, primary slowing of the heart action followed by a secondary quickening and increase in the rate and amplitude of breathing.

TYPICAL STATISTICAL STUDIES OF TOBACCO EFFECTS

Numerous statistical studies of the effects of tobacco smoking have been reported and the following cases may

⁴A. D. Bush, "Tobacco Smoking and Mental Efficiency," *New York Medical Journal*, Vol. XCIX (1914), pp. 519 ff.

be taken as representative of them. Meylan ⁵ examined the scholarship records of over two hundred Columbia University students, of whom 115 were smokers and 108 were non-smokers. The academic records of the two groups are shown in Table XVI.

TABLE XVI. INFLUENCE OF TOBACCO SMOKING ON ACADEMIC RECORDS

	Average Entrance Marks	Average 1st 2 yrs.	Failures 1st 2 yrs.
115 smokers	89	62	10%
108 non-smokers	91	69	4%

Taylor ⁶ studied the average grades of 500 boys of a private school as compared with their tobacco habits and presents the statistics given in Table XVII.

TABLE XVII. TOBACCO HABITS AND SCHOOL GRADE

	AGE OF STUDENTS					
	12	13	14	15	16	17
Per Cent of Smokers	15	20	38	29	57	71
Grades of Smokers	73	75	73	75	75	68
Grades of Non-Smokers ...	83	90	89	84	87	85

The most recent data of this type came from Antioch College.⁷ They are based upon a study of smoking, "pursued with thorough care and in strict accordance with sound statistical methods." This material, gathered into Table XVIII, shows the difference in achievement of non-smokers

⁵G. L. Meylan, "The Effects of Smoking on College Students," *Popular Science Monthly*, August, 1910, pp. 170 ff.

⁶C. K. Taylor, "A Little More Truth about Tobacco," *Psychological Clinic*, Vol. VII (1913), pp. 153 ff.

⁷*Good Housekeeping Magazine*, April, 1926, p. 4.

and heavy smokers (three figures for light smokers). In all scholarship records the non-smokers excelled the smokers. Inhaling was found to lower the records of both the light and heavy smokers. The difference in average grade of the two groups, though small, is said to have a high degree of statistical reliability. The athletic records are interpreted to mean that athletes in preparatory schools take to smoking in college and "so increase the number of athletes among college smokers," but that the smokers do not retain their pre-eminence in sports.

TABLE XVIII. SMOKING AND COLLEGE ACHIEVEMENT

	Non-Smokers	Heavy Smokers	Light Smokers
Failure to make required grade	31.8	62.3	43.0
Per cent making grade of 4 or higher..	23.9	7.9	...
Average grade	3.51	3.14	...
Gained athletic letters in preparatory school	32.0		42.0
Gained athletic letters in college	12.0		12.0

These statistical results are not unequivocal, for there are fundamental sources of error that make it difficult to establish causal relationships between smoking and academic record. Shall the conclusion be that smoking is such a handicap to academic accomplishment as these figures suggest, that smoking is an indicator or symptom of intellectual inferiority, that smoking accompanies social and possibly other activities that are in whole or in part the cause of the scholarship, or that smoking and poor academic record are both the result of some deeper lying cause? Evidence might be presented in support of each of these alternatives. The reader is cautioned to take a highly critical attitude toward statistical studies of this nature, and especially toward the interpretations of them.

PHYSICAL EFFECTS OF TOBACCO

Experimental studies of this problem are not lacking, although there are few that satisfy the fundamental requirements of experimental technique. Most of the experiments concerning the influence of tobacco upon physical efficiency have been made with the ergograph, measuring the physical endurance of a limited number of muscles, in terms of amount of work done in a series of muscular contractions; or by the dynamometer, measuring the strength or force of single muscular contractions. M. Lombard⁸ found that a single cigar of moderate strength reduced muscular strength from 10.4 to 2.1 kilogrammeters (a unit of measure, meaning the work done in lifting a weight of one kilogram to the height of one meter) or a decrease in efficiency of 80 per cent. This depression began to disappear soon after smoking ceased, but complete recovery required more than one hour. The same investigator found that muscular contractions produced by electrical stimulation, instead of the individual's volition, were not reduced, and consequently located the depressing effect somewhere in the central nervous system. Feré found cigarette smoking to induce a state of depression, after an interval of fifteen minutes, showing itself in reduced capacity for work.

Not all investigators have found such striking results, among them being Rivers, Vaughan and Harley and Hough. Their reports show a change after smoking no greater than that which occurs normally at different periods of a day, while one of them seems to find a slower fatigue rate after smoking than occurs normally. Rivers' explanation of the slight decrease in efficiency found in his own tests is interesting. The circumstances surrounding the act of smoking are stimulating, for instance, the sensory stimulation

⁸ See W. H. R. Rivers, *The Influence of Alcohol and Other Drugs on Fatigue* (Arnold, London, 1908).

from the odor and the taste of tobacco, and are in themselves causes of increased efficiency. Consequently, the small decrease in efficiency from smoking is significant when compared with the expected increase from the sensory stimulation. This serves as an illustration of the complicated character of the whole experimental problem, and of the necessity for the most careful interpretation of data. The prohibition of smoking in all persons who are undergoing training for speed, strength and endurance tests, is a practical application of the belief in the deleterious effects of tobacco on physical efficiency.

MENTAL EFFECTS OF TOBACCO

The influence of tobacco on mental efficiency has been the subject of few important researches, and none has succeeded in eliminating all sources of error. It is in this type of work that suggestion plays its largest part and where the necessity for control subjects is greatest. This is especially true because the mental tests of efficiency are almost all subject to improvement from practice and often a great improvement may be noted from one repetition of the test to another. In the absence of controls, improvement from practice might be wrongly attributed to the stimulating influence of tobacco, or might hide a real decrease in mental efficiency.

The latest and most thoroughly controlled investigation of the effects of tobacco smoking is that of Hull,⁹ carried out with the support of the American Committee for the

⁹ C. L. Hull, "The Influence of Tobacco Smoking on Mental and Motor Efficiency," *Psychological Monographs*, Vol. XXXIII (1924), No. 150. Two other recent studies are: D. J. Carver, "The Immediate Psychological Effect of Tobacco Smoking," *Journal of Comparative Psychology*, Vol. II (1922), pp. 279 ff.; and R. L. Bates, "The Effects of Cigar and Cigarette Smoking on Certain Psychological and Physiological Functions," *Journal of Comparative Psychology*, Vol. II (1922), pp. 371 ff.

TABLE XIX. EFFECT OF SMOKING ON EFFICIENCY

	NON-SMOKERS			HABITUAL SMOKERS		
	Test Number			Test Number		
	1	2	3	1	2	3
Neuro-Muscular Processes						
Pulse Rate	+ 12.63	+ 3.07	+ 2.74	+ 8.09	+ 7.25	+ 4.52
Tremor of Hand	- 29.80	- 31.20	- 23.20	- 38.30	- 22.30	- 4.80*
Tapping	+ 1.35	- 1.14	- 0.39	- 1.40	- 0.90	+ 0.50
Muscular Fatigue	+ 32.20	+ 10.10*	+ 6.20*	+ 9.60*	+ 3.70	- 12.50
Sensory-Motor Processes						
A-Test, speed	- ?	- ?	- ?	+ 0.10	- 1.20	- 1.40
A-Test, accuracy	- ?	- ?	- ?	+ 22.20	+ 32.10*	+ 38.80*
Reading, reaction-time ...	+ 1.08*	+ 0.05*	+ 0.54*	+ 1.20*	+ 0.05*	+ 0.85*
Learning, reaction-time ...	+ 4.41*	+ 0.44*	+ 3.65*	+ 0.70*	+ 0.35*	+ 5.55*
Higher Mental Processes						
Adding, speed	- 2.94	- 3.43	- 2.96	+ 3.00	+ 4.58	+ 6.55
Adding, accuracy	- 26.50	- 36.00	- 17.50	- 2.40	- 3.40	+ 1.20
Memory Span.....	- 6.38	- 2.53*	- 6.46	- 5.22*	- 1.83*	- 3.95*
Rote Learning	- 8.02	+ 4.33	+ 3.61	- 10.10	+ 0.20	- 6.20

Study of the Tobacco Problem. He used all the controls that have been found essential in other drug studies and succeeded by an ingenious technique in preventing the subjects from knowing whether or not they were really smoking. The scope of his investigation, which suggests the limitations of his conclusions, is stated as follows: "To determine quantitatively the effect upon the efficiency of a dozen typical mental and neuro-muscular functions of young men, of smoking a large pipe of mild tobacco for a period of 25 minutes, the smoking to take place 1½ hours after a meal, the smoke to be blown from the mouth at once and not inhaled, and the effects to be traced for a maximum of 1 hour and 45 minutes after the smoking ceased." His results are summarized in Table XIX. The figures are in terms of percentage, stimulation or improvement in efficiency being indicated by a plus sign, and depression or loss by a minus sign. The figures having "a satisfactory statistical reliability" are printed in heavy-face type, all others in light-face type. A * means that the figures are probably reliable. The numbers 1, 2, 3 indicate the first, second and third test after smoking. Hull's conclusions may be stated in his own words:

In a final review of the various effects of tobacco enumerated above, it will be noted that only three of the 12 forms of behavior investigated reveal an unmistakable influence of smoking. Two of these (pulse and tremor) are essentially physiological. The interest of the present investigation, on the other hand, is primarily in the more strictly psychological processes. Of these, only one (Addition) shows an unmistakable effect. Several others show effects with a fair degree of reliability, however, and are entitled to consideration. Probably the two most significant tests of this intellectual group as revealing the influence of smoking on mental efficiency, are Complex Mental Addition and Rote Learning. The first, together with Reaction Time, may be presumed to give some indication of the effects of smoking upon ordinary routine thinking, which is essentially the functioning of old associative bonds. The evidence in this case is favor-

able to tobacco where the subject is accustomed to its use. Rote Learning, on the other hand, possibly supported by Memory Span, presumably indicates the effect that tobacco is likely to have where new associative bonds are in the process of formation, as in most school learning. The results in this case, while not so reliable, are unfavorable to tobacco. It must be remembered, of course, that the above formulations apply with strictness only to the first hour and a half after the termination of smoking. Generalizations from them must be made with extreme caution.

The more recent and the better controlled the experiments are, the smaller is the effect to be attributed to tobacco. Although no serious decrease in efficiency is recorded over the period covered by the tests, there is certainly not enough evidence for an increase in efficiency sufficient to justify its use for that purpose. As a means of enjoyment and bodily comfort, it has no particular advantages over the other forms of recreation except where the habit has already been firmly established. From the point of view of efficiency of function, therefore, its use cannot be recommended.

THE EFFECTS OF ALCOHOL

The effect of alcohol upon the human body has been the subject of controversy over a long period of years. The numerous statistical studies and experiments have produced conflicting results for a number of reasons. Among these is the fact that, while in small quantities alcohol may act as a food, in larger quantities it becomes a poison; also that, while it stimulates one set of organs, it depresses others; and finally, there are such striking individual differences in resistance to the effects of alcohol that the choice of the few persons for study may predetermine the results.¹⁰ Added

¹⁰ A splendid survey of the effects of alcohol upon the human body will be found in E. H. Starling and others, *The Action of Alcohol on Man* (Longmans, Green and Co., New York, 1923).

to these causes of confusion are the sources of error common to drug experiments which were mentioned at the beginning of this chapter. Especially important is the factor of suggestion or expectation. Most persons have rather firmly fixed notions concerning the effects of alcoholic drinks, and investigators have often been influenced by their preconceived opinions either as opponents or as defenders of the use of alcohol.

EXPERIMENTAL STUDIES OF ALCOHOL EFFECTS

No description of the early studies of alcohol will be given, because failure to standardize procedure and eliminate errors has resulted in a great variety of conflicting conclusions. Rivers¹¹ was the first investigator to disguise properly the alcohol in a mixture so that it could not be detected by the person taking it, and thus largely eliminated the influence of suggestion. He found practically no effect upon muscular work from taking alcohol in doses ranging in size from 5 to 10 cubic centimeters. Effects previously found by others from such small doses he attributed to the sensory stimulation and the expectation of stimulating effects. Even doses as large as 40 cubic centimeters did not produce entirely consistent results in all cases. Sometimes there would be an increase and sometimes a decrease in total work done. Wherever an effect was noted, however, it consisted in a change in endurance or duration of the work rather than in the quantity of work done per unit of time. (Measured by the total number of muscular contractions on the ergograph, rather than by the extent of the single contractions.)

After reviewing all the work upon the mental and motor effects of alcohol, Rivers concludes:

¹¹ W. H. R. Rivers, *The Influence of Alcohol and Other Drugs on Fatigue* (Arnold, London, 1908).

In the case of muscular work, we have seen that there is definite evidence that small doses, varying from 5 to 20 cc. of absolute alcohol have no effect on the amount or nature of the work performed with the ergograph, either immediately or within several hours of their administration, the results previously obtained by other workers being almost certainly due to defects of experimental method. With a larger dose of 40 cc., there was evidence in one case at least of an increase in the amount of work under the influence of the substance; but the increase was uncertain and inconstant, and the possibility cannot be excluded that it was due to disturbing factors. . . . In the case of mental work, the available evidence points to a decrease in the amount of work under the influence of alcohol when there is an effect at all; but there are very great individual differences, even the large dose of 100 cc. failing to show any effect in some persons.

Dodge and Benedict,¹² working in the Nutrition Laboratory of the Carnegie Institute, found that, instead of alcohol being a general stimulant as is commonly supposed, it is really a depressant. In only one case, namely, the pulse rate, did they find an acceleration; but even this was not an absolute increase in rate and represented only the absence of the gradual decrease in pulse rate in the course of moderate mental and physical work. In the case of simple reflex and sensory processes, this depression expressed in per cent is as shown in Table XX.

Concerning the influence of alcohol on mental efficiency, popular opinion must be clearly distinguished from the results of scientific experiment. Alcohol in small doses is commonly supposed to increase mental activity, and to produce a feeling of general well-being, effects which quickly disappear when larger doses are taken. Under careful experimental conditions, Dodge and Benedict found that memory and association were only slightly affected and in the

¹² R. Dodge and F. G. Benedict, *Psychological Effects of Alcohol* (Carnegie Institution of Washington, District of Columbia, 1915).

TABLE XX. INFLUENCE OF ALCOHOL ON SIMPLE MOTOR REACTIONS

	<i>Per Cent</i>
Increase of latent time of the knee jerk	10
Decrease in thickening of the quadriceps muscle..	46
Protective eyelid reflex, latent time increased	7
Extent of eyelid movement decreased	19
Eye reactions, latent time increased	5
Speed of eye movements decreased	11
Sensitivity to electric stimulation decreased	14
Speed of finger movements (tapping) decreased..	9

direction of a decrease in efficiency. Other experiments upon mental multiplication of four-place numbers and upon typewriting show little or no effect from doses of alcohol varying in size from 5 to 40 cubic centimeters, either in quantity of work done or in its quality. One other research on attention, as measured by the ability to hit a moving target, indicated that after a dose of 15 cubic centimeters of alcohol one person was not at all affected while the efficiency of the other was slightly reduced.

The most extensive study of the influence of alcohol upon those mental and motor processes that are normally under voluntary control has been made by Hollingworth.¹³ The tests used were as follows: pulse rate, steadiness, coördination of hand and eye, speed of tapping, speed of color naming, speed of adding, opposites test, speed of learning and memory. The alcohol was administered in the form of beer, and for control purposes the same kind of beer was employed except that the alcohol had been extracted. The test schedule was so arranged that the effect of the alcohol could be measured against performance earlier in the day before the alcohol was taken, against days when only the

¹³ H. L. Hollingworth, "The Influence of Alcohol," *Journal of Abnormal and Social Psychology*, Vol. XVIII (1923), pp. 204 ff and 311 ff.

control dose was taken, and against days when neither alcohol nor the control was taken. The records for one of the tests, Addition, shown in Figure 21, will illustrate the nature of the results. The points on the base line of the figure indicate the different test periods during the day, while the break in the line shows the intervening lunch period when

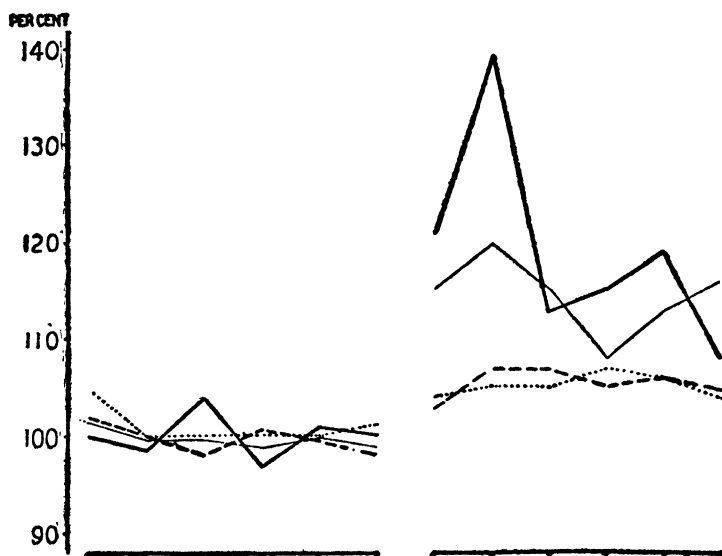


FIG. 21. THE MENTAL EFFECTS OF ALCOHOL

the drink was administered. There were six tests before and six after the dose. The vertical scale is in terms of per cent of the average morning score, which is taken as 100. Each point on the scale is the average of the records of six subjects on two different days, or twelve records in all. The solid line represents large alcohol days (5 to 6 bottles), the fine line, small alcohol days (3 to 4 bottles), the broken line, the control days (beer without alcohol), and the dotted line, blank days (no beer at all). The six morning records

TABLE XXI. INFLUENCE OF ALCOHOL ON MENTAL AND MOTOR EFFICIENCY

	Blank	Control.	BOTTLES		
			3-4	5-6	6-9
Pulse	- 7	0	+ 8	+ 10	+ 19
Steadiness	+ 11	- 21	- 68	- 241	- 370
Tapping	- 2	0	- 7	- 13	- 14
Coördination	+ 3	- 2	- 6	- 10	- 20
Color Naming	- 6	- 3	- 2	- 7	- 12
Opposites.....	- 2	- 7	- 5	- 12	- 23
Adding	- 4	0	- 5	- 10	- 15
Substitution	- 1	- 5	- 4	- 9	- 6
Memory			- 21		- 60

are free from alcohol effect regardless of the type of day, because the dose was taken at noon. As the records are in terms of time required to perform a given task, higher scores mean poorer records. Any differences in the morning records are the result of accidental variations or practice. It will be seen that all afternoon records are poorer than morning records, regardless of whether alcohol was taken or not. This is merely a case of the daily work curve which is described in Chapter X. The blank days and the control days are practically the same, as would be expected, since there was no alcohol in either case. The large dose shows a considerable impairment at the first test period, increasing in the second and then decreasing through the remaining tests. The small dose shows the same characteristics but less exaggerated. In the case of Addition, the curves return almost but not quite to the point reached by the blank and control curves at the end of the final test period. The records for all the other tests present the same general characteristics.

The data for all the tests are given in condensed form in Table XXI. In all cases the figures are in terms of per cent

of forenoon records, "plus" meaning improvement and "minus" meaning impairment of efficiency. The author concludes as follows:

In all of the mental and motor tests here 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 learning 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.

In all cases the effect varies directly with the size of the dose. In the association processes the effect of the smaller doses here employed has disappeared by the end of the experimental day, three hours after the conclusion of the drinking period. In the case of the motor processes (tapping, steadiness and coördination) and pulse rate, recovery is slower, and even in the case of the smaller doses there is usually inferior performance or change of rate at the end of the day.

OTHER EVIDENCE CONCERNING ALCOHOL EFFECTS

A new sort ¹⁴ of investigation has been undertaken recently to determine the influence of alcohol on mental processes, and it promises valuable results. Tests are being made of the effects of alcohol on the intelligence of animals, as indicated by their ability to learn to find their way out of a maze. It has been reported that "rats fed on alcohol average a longer time in the maze and make more errors both at the beginning and during the latter part of the training period than normal rats." Another investigator finds that a dose of alcohol given to a rat immediately after a learning period will nullify the effects of the learning. The value of such work lies in the amount of control over the subjects, and the simplicity of the conditions of the experiment.

¹⁴ A. H. Arlitt, "The Effects of Alcohol on the Intelligent Behavior of the White Rat and Its Progeny," *Psychological Monographs*, Vol. XXVI (1919), No. 115.

Evidence concerning the influence of long-continued use of alcohol is not experimental in character, but consists in reports of military campaigns and the like, in which the whole problem is extremely complicated, so much so that the inferences concerning endurance under alcohol are of little significance. The conclusions that have been reached are that alcohol decreases endurance and increases susceptibility to fatigue.

Pathological evidence of the effects of alcohol is more definite, although here extreme cases are usually cited. Examination of the tissues of confirmed drunkards after death shows pathological changes in stomach, liver, heart and especially in the nervous system—findings which lead to the classification of alcohol as a tissue poison when its use is immoderate and continued for long periods.

One further fact in regard to effects of alcohol may be mentioned, namely, the relation between alcoholism in the parents and the mentality of offspring. Statistics show that the percentage of feeble-minded persons in the families of alcoholics is much higher than in the families of non-alcoholics—according to Goddard¹⁵ sometimes 35 per cent higher. Hence, we might conclude that alcoholism almost doubles the number of feeble-minded. But the case is not perfectly clear, for the alcoholism itself may be the result of feeble-mindedness in the parent, and in that case the feeble-mindedness would be transmitted directly to the children. The conclusion drawn by Goddard is significant:

Everything seems to indicate that alcoholism itself is only a symptom, that it for the most part occurs in families where there is some form of neurotic taint, especially feeble-mindedness. The percentage of our alcoholics that are also feeble-minded is very great. Indeed, one may say without fear of dispute, that

¹⁵ H. H. Goddard, *Feeble-mindedness: Its Causes and Consequences* (The Macmillan Co., New York, 1914).

more people are alcoholic because they are feeble-minded than vice versa.

This conception of alcoholism as an effect rather than as a cause has formed the nucleus for a very voluminous literature within the last few years. The psychoanalysts see it as a malady which their treatment will cure, as indicated in the following paragraph from Rivers: ¹⁶

Our new psychological knowledge has had a great effect on the modern treatment of alcoholism in the individual. In the older modes of treatment the chief remedy was removal for prolonged periods from the temptations caused by ready access to the means of obtaining alcohol, combined with appeals to reason, based largely on moral considerations. In some cases where it was only necessary to break a morbid habit, these lines of treatment were efficacious, but failures were numerous. Modern methods of treatment are based on the view that in many cases alcoholism is only a means of escape from some situation which the sufferer is unable to endure without the assistance provided by the lowering of sensibility and diminished powers of appreciation produced by alcohol. In other words, resort to alcohol in such cases is a substitute for repression, or perhaps more correctly, it is a process by which a state allied to repression is produced by artificial means. The treatment now adopted is on the same lines as that for repression. The sufferer is taught to face his trouble, probe it to its source, and discover how it may be possible to live with it in peace so that it will be no longer necessary to have recourse to the paralyzing agency of alcohol.

Practical conclusions are not difficult to draw in the case of alcohol and efficiency. Alcohol may possibly be taken in small quantities with benefit by the aged and certain types of invalids, where it may serve as a food. But over against this is the evidence that it is not a stimulant to increased efficiency for normals, but rather a depressant. In addition, alcohol belongs to the class of habit-forming substances,

¹⁶ W. H. R. Rivers, *Psychology and Politics* (Kegan, Paul, London, 1923), p. 74.

against indulgence in which the body offers no check, such as is present in the case of overeating. Thus there is great likelihood of indulgence until the body tissues are injured. There is no doubt of the ill effects of the excessive use of alcohol. Large industries and railroads are beginning to recognize the danger from its use and have made abstinence a necessary qualification for employment. The decrease in the use of alcohol as a medicine by physicians is evidence that even in this field it is not indispensable.

THE EFFECTS OF CAFFEINE-CONTAINING SUBSTANCES

Caffeine as the active principle of many of the common beverages, such as coffee, tea and soda fountain drinks, has been the subject of many investigations. Since it is so commonly used by persons who shun any other stimulating drinks, it is important that its real effect should be known. The popular impression is that it acts as a stimulus to both muscular and mental work, especially the latter. There is much evidence that coffee and tea and other substances containing caffeine should be called habit-forming drinks. The person who cannot be deprived of his strong coffee or tea without getting a headache, or at least being incapacitated for work, is a common spectacle. And an equally familiar case is that of the person who is kept awake all night by an after-dinner cup of coffee, or the student who drinks a cup of coffee to enable him to continue his studies beyond the hours when he usually retires. Are these popular notions supported by the results of experimental work?

As in the case of the other drugs studied, most of the early work has produced conflicting and inconclusive results. With the exception of one or two of the recent studies, the effect of moderate doses of caffeine taken in the form of tea or coffee is found to be a stimulation, producing an increase in the amount of muscular work done on the ergograph and the dynamometer. But although the careful work

of Rivers¹⁷ confirmed these findings, his experiments designed to exclude all mental factors such as suggestion and interest show a much smaller increase than the earlier experiments. As in his work with alcohol he attributed this discrepancy to the failure of these workers to disguise the drug. Great differences were found by him in the susceptibility of different persons to the drug, and in the duration of the effect. The tests of speed of movement, motor co-ordination and steadiness made by Hollingworth¹⁸ on sixteen subjects over a period of forty days, in which every known precaution against errors was taken, show interesting physical effects of caffeine. It produced an increase in the speed of movement, the amount, which depends on the size of the dose, being about 4 per cent in a group of 12 persons. The doses ranged from 2 to 6 grains, the equivalent of which in terms of coffee and tea may be seen from the figures in Table XXII.

TABLE XXII. CAFFEINE CONTENT OF COFFEE AND TEA

	<i>Grains of Caffeine</i>
Average cup of hot black tea contains.....	1.5
Average after-dinner cup of black coffee contains	1.5
Average glass of cold green tea contains	2.0
Average cup of coffee with milk contains.....	2.5

The effect was noted usually within an hour after taking and lasted from 1 to 4 hours, according to the size of the dose. What is perhaps one of the most important findings is that no secondary depression followed the stimulation for a period of 72 hours, when record-taking ceased.

The Motor Coördination Test, combining speed and accuracy of movement, shows a somewhat different result. Small

¹⁷ W. H. R. Rivers, *The Influence of Alcohol and Other Drugs on Fatigue* (Arnold, London, 1908).

¹⁸ H. L. Hollingworth, "The Influence of Caffeine on Efficiency," *Archives of Psychology*, No. 22 (1912).

doses produce stimulation, while larger doses, 4 to 6 grains, cause a retardation or decrease in efficiency following a brief initial stimulation. The greatest retardation noted for five persons averaged only 2.7 per cent. Individual differences were prominent, with clear evidence that the magnitude of the effect varies inversely with the body weight of the person. The Steadiness Test, designed to give an indication of general nervousness, showed that doses of 1 to 4 grains produced slight nervousness, appearing several hours after the drug was taken. Larger doses of 6 grains produced greater nervousness, appearing sooner and increasing during a period of several hours.

MENTAL EFFECTS OF CAFFEINE

Fewer tests have been made of the mental effects of caffeine. Only two will be mentioned. Rivers found an increase in typewriting speed with no influence upon accuracy and in the Aiming Tests mentioned earlier he found increased concentration of attention. Hollingworth used three groups of mental tests: (1) Association Tests, including the naming of simple colors, naming opposites to each of a series of words, and problems in simple addition. In this group of tests, doses of every size from smallest to largest produced a stimulation, which reached a maximum of 15 per cent in the Opposites Test, and varied from this amount to very slight improvement in others. The effect lasted from three to seven hours, with no secondary reaction showing in any retardation that could be measured. (2) Choice Tests, including the speed of perception and cancellation of specified characters from a large group of varied characters, and the speed with which visual objects could be discriminated and a movement appropriate to each be made. (Reaction by the right hand when a blue color was seen and by the left hand when a red color was seen.) In this group a rather curious effect was noted. Small doses produce re-

tardation with decrease in quality of work. Larger doses, however, produce a stimulation within two hours, which may last until the following day. (3) Typewriting Tests, concerning which Hollingworth says:

The speed of performance in typewriting is quickened by small doses of caffeine and retarded by large doses. The quality of the performance, as measured by the number of errors, both corrected and uncorrected, is superior for the whole range of caffeine doses to the quality yielded by the control days. Both types of errors seem to be influenced to about the same degree. The increase in speed is not gained at the expense of additional errors, but increased speed and decreased number of errors are simultaneously present.

OTHER EFFECTS OF CAFFEINE

These experiments also present evidence of the effect of caffeine on sleep and general health, when rigid experimental conditions are in force. Extremely large individual differences were discovered. For most of the subjects, doses of 1 to 4 grains did not affect the quality or quantity of sleep; although there were a few individuals whose sleep was impaired. With doses of 6 grains, however, the sleep of most of the persons was disturbed although even here there were exceptions. The greatest effect was always obtained when the drug was taken on an empty stomach. The most important factor in producing the individual differences seems to be the differences in the body weight. As far as general health is concerned, certain effects were manifested when the doses were larger than 4 grains. Headaches, dizziness, feverishness, irritability and the like were reported, especially by the subjects lightest in weight.

The experiments described lead to the following conclusion as stated by Hollingworth:

The widespread consumption of caffeinic beverages under circumstances in which and by individuals for whom the use of

other drugs is stringently prohibited or decried seems to be justified by the results of experiment. But it should be emphasized that the results of the investigation here reported bear only on the more or less immediate effects of caffeine on performance. It is true that the investigation as a whole covered a period of 40 days, and that in the intensive experiment the effect of single doses was traced for a period of 3 days. But the results cannot be carried over bodily to the question of the continuous use of the drug. One can only assume that if the constant use of caffeine in moderate amounts would prove deleterious, some indication of such effect would have shown itself in the careful study of performance in tests covering a wide range of mental and motor processes, a wide range of doses and of individuals, and of time and conditions of administration. Nor can anything be said, on the basis of these results, concerning the physiological or neurological effect of caffeine, except in so far as integrity of structure can be inferred from unimpaired function or performance. . . . It should be further pointed out that . . . tea, coffee, and other caffeinic beverages . . . contain a variety of other substances which may be supposed to enhance or neutralize or otherwise modify the effect of the caffeine content. Many of the results commonly attributed to these beverages undoubtedly come, in so far as they can be demonstrated at all under controlled conditions, from these non-caffeine ingredients.

INDIVIDUAL DIFFERENCES IN SUSCEPTIBILITY

Individuals differ in susceptibility to the effects of drugs, as common experience and experiments both show. The basis of these idiosyncrasies is not clearly understood, and many different factors are probably involved. Recent studies show that susceptibility is related to general mental competence as embraced in the concept of general intelligence. The more susceptible individuals are those whose original ability in the tests employed is inferior. Those whose normal records are superior and who display the ability, also, to improve notably through practice, most successfully resist the influence of the drug on performance in the tests. It is just these abilities which are commonly taken to be indications of relatively superior intelligence. Resist-

ance to drugs, as well as freedom from neurotic involvement, characterizes the superior organism. It might be added that along with the resistance to drugs there goes the freedom from the tendency toward excessive use of such drugs, as a trait of the superior organism. At least, such is the case if the interpretations of drug addiction as results rather than as cause are to be accepted. Such considerations as these give an increased importance to drug studies and suggest that experimental pharmacopsychology may make significant contributions to our more general knowledge of human nature.¹⁹

¹⁹ This matter has been developed at some length by H. L. Hollingworth, "The Influence of Alcohol," *Journal of Abnormal and Social Psychology*, Vol. XVIII (1923), pp. 321 ff.

PART II

**PSYCHOLOGY APPLIED TO
OCCUPATIONAL ACTIVITIES**

CHAPTER XIV

THE PRINCIPLES OF VOCATIONAL PSYCHOLOGY

THE selection, for particular kinds of work, of those persons whose adjustments are adequate, and the analysis of occupations to determine just what specific adjustments are required, constitute vocational psychology. Not every kind of work can be done equally well by every individual, hence misfits in vocations are constantly occurring. Incompetent persons are placed in responsible positions or otherwise competent persons are placed at tasks for which they may be found to have either no inclination, a strong dislike, or perhaps no particular aptitude. Such "misfitting" contributes largely to high labor turnover, with its consequent loss to the employer through inefficient service, and through the necessity of constantly training new workers; and with its tendency to discourage and dissatisfy the worker and engender in him shiftless habits.

The results of poor vocational adjustment are so generally evident that all sorts of devices have been sought and tried in order to fit the worker to his appropriate task. Impressionistic interviews, analysis of photographs, letters of recommendation, letters of application, application forms, phrenological and physiognomical descriptions, and numerous other diagnostic aids have in turn been tried and found to be either utterly absurd or manifestly inadequate to determine general or specific fitness. The need for an immediate remedy has led in recent years to the construction of mental tests and measuring scales which have been frequently quite as inadequate as the older methods because of hasty con-

struction or because of content entirely unsuited to the purpose. Under the circumstances it seems advisable to seek for certain very general principles according to which the various methods may be evaluated. An attempt will be made in this chapter to formulate such general principles.¹ First, however, it is necessary to examine several terms which are commonly used in discussing vocational problems and which are frequently misunderstood.

VOCATIONAL SELECTION AND VOCATIONAL GUIDANCE

Vocational selection means choosing a person for a particular job. There is one job but more than one candidate. In order to select the candidate correctly, the traits required for the job must be known, and means must be at hand for discovering and measuring these traits in the candidates. Vocational guidance, on the other hand, means choosing the occupation for which a given person is best fitted. There is one individual and a variety of jobs among which to choose. In order to make such choice one must have at hand devices for making a thorough analysis of the individual, and determining the degree to which he possesses a great variety of traits. Furthermore, a large number of occupations must have been analyzed in order to determine the traits, and the degree of each trait, required by each occupation. Vocational guidance, therefore, is exceedingly laborious and difficult compared with vocational selection. Whereas vocational selection is possible in certain specific occupations, vocational guidance of the individual can be conducted only with misgivings. The two forms of vocational service differ also in the consequences of error. In vocational selection the employer will know, at least approxi-

¹ Parts of this chapter appear in A. T. Poffenberger, "A Critical Examination of the Usual Employment Methods" (*The Annals of the American Academy of Political and Social Sciences*, November, 1923), Vol. CX, pp. 13 ff.

mately, the risk that he runs of making a mistake. At the worst he will have to choose and train a new employee. But the cost of error for the individual in the choice of his work may be serious and even irreparable, where a long course of training is involved. By far the largest share of calls for vocational service is for individual counsel or guidance. Confusion between these two forms of service leads to undue expectations and disappointment.

NATIVE AND ACQUIRED CAPACITIES

The troublesome question of what is native and what is acquired in human behavior has a practical bearing upon psychological methods employed in vocational work. The distinction that is frequently made is between potential capacity or capacity for development and acquired capacity (or ability) which embraces what the individual has been able to learn as a result of his native capacity plus whatever training he has received. It is recognized to be quite impossible to make a sharp distinction between the potential and the actual, and yet such distinction as can be made is useful. For instance, two candidates apply for a position of typist. One has had very little training and the other has had an extensive special training. The latter will make a better immediate showing than the former, and yet the former might, in the course of very little additional training, far outstrip her competitor because of a higher degree of natural capacity. An employer who wanted immediate service of a given standard would choose the trained candidate, while one who would be willing to choose a candidate who had great possibilities of growth would certainly choose the other. It is generally a much simpler task to measure acquired accomplishments than potential capacities. One knows at once in what terms the measurements are to be made. To measure typing ability, it is necessary only to measure samples of typing performance. But to measure potential capacity

for typing the proper measures are not so obvious, and in fact the functions tested may bear no resemblance whatever to the typing operation. In many cases of vocational selection and in all cases of genuine vocational guidance, the native capacities rather than acquired accomplishments need to be measured.

MEASURES OF CONDUCT OR BEHAVIOR

There are three very general requirements that tests for vocational purposes should satisfy. The first of these requirements is that the trait ultimately measured shall be a conduct or behavior trait and not some fixed anatomical characteristic. Apparent exceptions to this rule will, doubtless, readily come to mind. For instance, the quality of the musculature of a candidate for blacksmith's helper may be the proper characteristic to measure, but surely this is an anatomical trait. It would be a good measure, however, only if it indicated strength and endurance, which are behavior traits. Again, the lines of the face may be thought of as anatomical characters, yet it is conceivable that they are the results of habitual forms of facial expression and hence useful for certain particular purposes as prophetic of such expression. Physical and anatomical peculiarities, when direct indicators of conduct, will conform to our first rule. There are many such structures that, as far as can be detected, have no direct relationship with the conduct in which the vocational psychologist is interested, or in fact with any form of conduct whatever. Among these are the texture and pigmentation of the skin and hair, the color of the eyes, the conformation of the skull, the distance between the eyes, and other facial dimensions.²

² The most recent investigations into the functions of the internal secretory organs and their relation to physical development on the one hand, and the development of mentality on the other hand, might seem to suggest the practical utility of such indicators. These

There is one other possible exception to this rule that deserves consideration. A tall, robust individual may make the best doorman, and the same type of man may make a better executive than one possessing all other traits to the same degree, but who is small in stature. As a matter of fact it appears from a survey³ of the physical makeup of executives that they are taller and heavier than the average man. There is little doubt that a similar survey of doormen would bring like results. Wherever the main function of the incumbent of a position is to serve as an ornament, physical traits would play an important part. But such interpretation will not cover many cases other than that of doorman. If there is a general expectation among people that tall, heavy individuals are good executives, that expectation would in itself account for the greater height of executives, since they would in part be chosen for the possession of that trait. But more than this, it might conceivably make them better executives. For the success of an executive, in so far as this work involves relations with other people, depends upon the attitude of others toward him, their submissiveness, confidence, etc. Such a belief in the executive ability of large individuals, if sufficiently widespread, would have some effect, even if erroneous. The possibility of any widespread prevalence of such beliefs is remote. The point should be noted, finally, that there is a logical fallacy involved in the notion that, because executives are above the average man in height, therefore men above

findings have great scientific interest but there is scarcely any hope of their practical application. Where the relationship between structure and conduct has not been actually zero, it has been so slightly positive as to make prediction for vocational purposes quite impossible. For a survey of literature and original data on this question, see R. C. Sommerville, "Physical, Motor and Sensory Traits," *Archives of Psychology*, No. 75 (1924).

³E. B. Gowin, *The Executive and His Control of Men* (The Macmillan Co., New York, 1915).

the average height will make better executives than shorter men.

THE FORMS OF CONDUCT SHOULD BE SIGNIFICANT

The second rule is that the conduct or behavior that is measured shall be significant for the vocation in question. Omitting physical and anatomical traits, there is in conduct an unlimited range of material for vocational measurement purposes. This is especially true if the term conduct is extended to include, as it should, conduct crystallized in work done, words written, and features molded and shaped through frequent activity and use, if such be possible. Not every form of conduct, however, will serve as an indicator of particular vocational aptitude. In fact there are many forms of conduct that have no diagnostic value whatever for any known purpose.

An employment manager examining a candidate for the position of salesman, may note the way he enters the room, the appearance of his clothing, his manner of shaking hands, the way he settles into his chair, his manner of conversation, or a dozen other forms of behavior. Are these vital factors in salesmanship? They may be, since that occupation demands social contacts, the making of a good impression, the arousal of confidence and the like. On the other hand, if the employment manager happened to be selecting a filing clerk, these same traits might have no significance, since that is not an occupation depending for success upon effective social contacts, but presupposes the possession of quite other talents. The significance of the behavior trait cannot always be determined by mere inspection or the task of the vocational psychologist would be much simpler than it is. Only painstaking investigation will reveal, in most cases, those forms of conduct that are indicative of any particular vocational aptitude. The methods of determining their significance will be dealt with in succeeding chapters.

ADEQUATE MEASURES OF CONDUCT

The third rule is that the measurement of the significant conduct shall be adequate. If, for example, it should be found that ability to look a person in the eye is a significant indicator of the type of aggressiveness required in salesmanship, it will not be sufficient to say that one can or cannot do this. It is not necessarily a characteristic that is either present or absent, but one that is possessed in varying degrees by all persons. It will be necessary to determine how long and how steadily one should be able to control the movements of the eyes in order to be called aggressive. It will be necessary also to find whether ability to stare another person in the eye and aggressiveness are so closely related that the presence of one trait can be definitely predicted from the presence of the other. In the same way, it may not be sufficient to say that a candidate has a vigorous and vital handshake, but that it is more so than that of the other candidates. So it is with all the other characteristics that are measured for vocational purposes. It is seldom, if ever, merely a matter of "Yes" or "No," but rather of "How much?" and "How many?" Answering such questions as these demands the use of quantitative measuring methods comparable with those used in the physical sciences. Some of the important devices will be illustrated in later chapters.

SELECTION BY FIRST IMPRESSION

Before examining the strictly psychological methods of vocational measurement, it is pertinent to inquire to what degree the customary and widely used employment methods meet our three requirements. In the present era of test enthusiasm, care should be exercised not to discard too readily the established means, until their lack of utility has been thoroughly demonstrated. For in the final analysis, the line be-

tween what is a test and what is not a test cannot be sharply drawn. The difference is frequently one of technique rather than of content.

Many employers of men boast of their ability to judge correctly the fitness of an applicant for a job upon the first impression that he makes, his gait, his manner of speech, the appearance of his clothing, the warmth of his handshake, the way in which he meets a rebuff, etc. These are forms of conduct and a quick survey or estimate of them is possible. Is the conduct thus observed significant? To the extent that the conduct is an adequate representation or sample of the future work, as in selling, secretarial work, and some kinds of executive duties, it may possibly be significant. If, on the other hand, the applicant is being considered for a position as accountant, clerk, or skilled mechanic, the case is not so clear. We are then no longer dealing with samples of the occupation but with more or less fictitious symptoms. First impressions cannot, therefore, be considered significant until proven so, and they are almost certain to be found of little value for all but a very few occupations.

In applying our third rule it is necessary to inquire whether the measurement of the conduct in these first impressions is adequate. Does the employment manager properly gauge the impression that the applicant will make upon his customers, if he is to be a salesman? He is very likely not to. The unchecked reaction of any one human being in a case like this is likely to be subject to a great variety of prejudices. Dislike of red hair, of a long nose, a preference for blonds, for tall persons, for snub noses and other non-significant traits may have a subtle influence on the judgment. That such distorting influences are at work seems plausible in the light of the results of interviews such as are presented in Table XXIII. As it is not likely that all persons will be subject to the same idiosyncrasies, the reactions of more than

one person would seem to offer better measures of fitness. Since the efficiency of the applicant will depend upon the impression that he makes upon the general run of his customers, the nearer the judges form a sample of these customers the more satisfactory will their opinion be. That employment manager whose reactions to an applicant will be representative of those whom the individual is to serve is, doubtless, rare.

A further question arises as to the terms in which the judges shall record their impressions so that their opinions can be combined in usable form, and so that the recorded judgments shall be fine enough to discriminate among the various applicants. Some kind of predetermined marking system must be employed, which shall be equivalent for the different judges. Finally, it may be necessary to specify certain qualities that the judges are to look for so that overemphasis may not be placed on any one trait such as neatness of dress, carriage, etc., and so that equally important traits may not be excluded entirely from consideration. The application of the three rules to estimates from first impressions shows, therefore, that such judgments would be effective only in the few instances, if any, where first impressions are vital factors in success, and only there when they bulk so large as to constitute a significant sample of the whole job, when these impressions are recorded by a sufficient number of observers, and recorded in suitable fashion, and when weight is given to each quality according to its relative importance. When the first impressions gained from actual contact with the candidate are replaced by impressions gained from a photograph, as is sometimes the case, the effectiveness of such judgments becomes still more questionable. The real conduct indicators are almost, if not entirely, missing and physical traits take their place. Where personal appearance is a vital factor in success, it may be determined to a certain degree from a photograph. But

even such a trait as neatness can be estimated only with considerable error.⁴

SELECTION BY INTERVIEW

Very closely related in general character to this method of first impression is the interview. It may be merely a means of getting an impression. Questions may be asked for no other purpose than to afford good opportunity for observing the reactions of the applicant. When the interview is of this nature, the same conditions as described above will apply. But very often the interview is intended to do more than this. It is so conducted as to elicit information concerning the individual's past, his interests, desires and capacities which are thought to have a bearing upon his future success. When of this type, the interview must comply with the same rules laid down for first impressions. It should, first of all, deal with conduct and records of conduct. Whether the conduct thus investigated is significant for the purpose is a question which must be determined specifically for each occupation. For in this case we are no longer dealing directly with an actual sample of the kind of performance an individual is to engage in, that is, making a favorable impression, but we are dealing with symptoms, more or less remote, of capacity to do certain kinds of work. One cannot prophesy safely, without a checking up, whether, in salesmanship for example, certain information about a candidate's past will have any bearing upon his future success, or still less, what is the relative importance of the various items of information thus obtained.

In spite of the importance of the whole question, the value of such symptoms has rarely been adequately investi-

⁴For a survey of experimental material on this subject, see H. L. Hollingworth, *Judging Human Character* (D. Appleton and Co., New York, 1922.)

gated. One study ⁵ has been reported in which the relationship was determined between success as an insurance salesman in terms of earnings, and certain information of a biographical character such as is usually obtained from an interview. Such matters as "good health," "time spent in the work," "amount of schooling," "marital status," and "motive for taking up insurance selling," seem to have no bearing on success; while "having children," "starting work on commission," and "having outside recreations," seem to bear a positive relation to success. Now such facts as these could scarcely be discovered except by careful analysis of interview data checked against the objective facts of salaries earned. This study represents a form of job analysis which suggests what might be done and is being done in connection with many types of occupation.

Even after forms of significant conduct are discovered, they must be made the basis for carefully prepared questions whose answers should be capable of simple and easy record in their entirety and be free from the factors of guessing and personal bias of the interviewer. These answers may then be dealt with adequately and be objectively measured so as to get from them their maximum significance, instead of being passed on at the moment with nothing but the opinion of the interviewer as the result of the interview.

Furthermore, it is scarcely likely that all items of conduct found to be significant are equally significant. Perhaps, "having some outside recreation" may be only one-fourth as indicative of insurance selling ability as "having children," or perhaps their relative importance may be reversed. That is to say, the various items of information must be given weights in accordance with their importance as symptoms of

⁵ D. B. Goldsmith, "The Use of the Personal History Blank as a Salesmanship Test," *Journal of Applied Psychology*, Vol. VI (1922), pp. 149 ff.

success. The following are a few relative weights attached to qualities as symptoms of success which were worked out in one practical business organization: Age (within a given range) 3 points; Marital status, 1 point; Schooling (specified number of years), 1 point; Previous occupation (within a certain group), 1 point; Length of time with last employer, 1 point. These are matters which can be determined by one who is skilled in current statistical procedure and may put value into interview data which are worthless when not thus handled.

That interviews which do not comply with such rules as have been described are failures in a large proportion of the cases is suggested by the few experimental tests which have been made of them. Where equally qualified employment managers are allowed to use their own interview methods on the same group of candidates, the discrepancies are surprisingly great. It is not uncommon for the same applicant to be reported by one interviewer as the best of a group of fifty candidates and by another as the poorest in the group. More frequently still, there is no agreement as to whether a given applicant shall be placed in the poorer or better half of the group.

Table XXIII⁶ gives the data from such a test in which 57 candidates for positions as salesmen were interviewed by 12 sales managers of high standing and arranged by each in an order according to the impression created. Position 1 means the best candidate and Position 57 means the poorest candidate. Reading across the table discloses the different ratings given a candidate by the various judges. Candidate C, for example, is rated as best by one manager and as poorest by another. Other candidates made almost equally discordant impressions. In actual practice such errors are not

⁶H. L. Hollingworth, *Judging Human Character* (D. Appleton and Co., New York, 1922), pp. 62 ff.

TABLE XXIII. VARYING RESULTS FROM INTERVIEWS

Applicant	SALES MANAGERS											
	1	2	3	4	5	6	7	8	9	10	11	12
A	33	46	6	56	28	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
K	18	5	55	37	57	16	34	6	46	13	38	26
L	7	20	6	1	1	10	3	7	17	2	2	26
M	18	45	26	9	51	43	33	29	46	32	37	26
N	2	15	6	28	7	45	24	40	40	17	30	48
O	18	42	19	2	16	4	14	51	32	45	31	26

discovered directly and immediately on account of the lack of any adequate check upon selections. Not only is there no means of discovering the good candidates who failed to be employed but there is no tendency to attribute rapid turnover to the selection of the wrong individuals.

SELECTION BY LETTERS OF APPLICATION

The letter of application may be looked upon as a means of submitting a conduct record at long range. Sometimes it serves as a substitute for the personal interview and sometimes as a preliminary device for classifying applicants into "possible" and "impossible." In either case to be entirely effective it must comply with the three rules laid down in the beginning of this chapter. In ordinary practice one who is writing a letter of application is left entirely free to choose the general character and the content of the letter, and upon the basis of it a general opinion of his fitness is obtained.

Or, he may be asked to answer specific questions as to his past experience, marital status, age, interests, etc. If the application is of the former type, all that has been said in our discussion of the first impressions will apply. Certain additional difficulties must also be taken into account. First, there is the question of the veracity of the applicant. It is not uncommon for applicants to have some one else prepare their letters and to deliberately falsify their contents. This matter cannot well be checked without considerable difficulty. Then, too, there is the question of the ability of the applicant to judge himself rightly in regard to the matters upon which he reports. The following quotation sums up very well the facts in this regard: "The individual judges himself less accurately than others judge him, and on the whole self-estimates have only chance accuracy. The individual's judgment is moreover a biased one. He tends to overestimate himself or to underestimate himself according to the presumed desirableness of the trait. But those individuals who actually possess a given desirable trait in high degree are more accurate in their self-estimates for that trait than are those who possess the trait in lower degree."⁷ These statements refer to the judgment of personal character traits and not to such objective facts as age or previous experience.

When the letter of application is of the latter type, that is, bears information to be evaluated rather than offering merely a basis for gaining a general impression, it must be dealt with just as the interview data are dealt with. That is, the significant facts must be gleaned from the non-significant and these must be weighted according to their relative importance as symptoms of success. Furthermore, the personal bias of the judge must be eliminated. When these conditions are complied with, there is no doubt that the letter of applica-

⁷ *Ibid.*, p. 58.

tion may be of some service. In an experiment⁸ where twelve competent judges evaluated each of twenty-five letters of application for a given job, and the consensus of opinion was calculated for all the judges, this consensus of opinion was correlated with the actual capacity of the twenty-five people (as estimated by those who knew them in their work) to the extent of $+.50$. The correlations for the separate judges, however, varied from $+.24$ to $+.57$. In this study the honesty of the applicants was guaranteed. Each one was left free to choose the contents of his letter. Personal bias of the individual judges was eliminated by a consensus of opinion of twelve judges. When due weight is given to the safeguards mentioned and when the *limitations* of a letter of application are recognized, there is no reason why it should not be a useful tool in vocational selection.

In the case of letters of recommendation and testimonials a third party is introduced into the situation, which constitutes a new source of error and one that is difficult to control. Assuming for the moment that no new error is introduced by way of the writer of the testimonial, then exactly the same conditions apply as in the cases previously discussed. Significant conduct properly measured so as to eliminate personal prejudices and weighted according to its importance provides useful material for vocational selection.

The writer of testimonials and letters of recommendation is likely to view his task rather lightly and for mere accommodation will often exceed his knowledge or falsify it, in writing about a friend or associate. There is no way of checking against errors of this nature except to know the character of the writer and to demand testimonials from a number of persons. In the majority of cases this is not

⁸ A. T. Poffenberger and V. H. Vartanian, "Letters of Application in Vocational Selection," *Journal of Applied Psychology*, Vol. VI (1922), pp. 74 ff.

possible. Even where actual dishonesty or carelessness is not present, the fallibility of human judgment will play a part. Testimonials most frequently deal with the personal traits of an individual and it is in just such cases that the error of judgment is greatest.

SELECTION BY PHRENOLOGY AND PHYSIOGNOMY

There remain to be mentioned certain methods⁹ which comprise the interpretation of anatomical characteristics which in the light of our present knowledge have no relation, either direct or indirect, with conduct. Such methods are employed in business and industry to an extent that amazes the scientifically minded student. The technique employed seems to violate all the requirements of a diagnostic test. The reported successes are extremely difficult to verify, and if they do occur they are most likely to be attributed to the adoption of conduct measures either intentionally or unintentionally in place of the anatomical ones ostensibly used. Such devices are best driven from the field of vocational guidance and selection, not by attack upon them, but by the development of a technique of measurement whose value can be demonstrated to those who are looking for the best tool regardless of whence it comes.

⁹ These methods are discussed in detail in C. H. Griffitts, *Fundamentals of Vocational Psychology* (The Macmillan Co., New York, 1924).

CHAPTER XV

THE RÔLE OF JUDGMENT IN VOCATIONAL PSYCHOLOGY

THE survey, in the preceding chapter, of the common employment methods shows to what a great extent opinion and judgment enter into them. It should not be assumed that the introduction of test methods into vocational work will eliminate the need for such judgments. There are at least two reasons why this is true. In the first place, human traits differ considerably in the degree to which they lend themselves to objective and quantitative measurement. Some have objective and stable manifestations, such as the ability to do arithmetical computations, to write on the typewriter, to file cards or to turn out work on a lathe. They leave a record in the form of answers to problems, sheets of typed material, cards filed in their proper places, and correctly machined work. Other traits are much more subjective and illusory in nature, such as intelligence, honesty, aggressiveness and perseverance. Their objective records are less tangible and less easily evaluated. Even more subjective are cheerfulness, loyalty, refinement and many others. They are social traits and exist only as they make an impression upon one's associates and they reflect themselves most directly in the opinions of those with whom one comes in contact. Their objective manifestations are likely to be remote and intangible. It is the objective traits of the first sort and a few of the second sort that have been subjected to measurement by means of tests. Those of the third kind have not yet been found susceptible to such treatment. Yet the im-

portance of these so-called character and temperament traits in determining success in any vocation is unquestioned. Consequently, until better means are developed, and perhaps always in some cases, these traits will have to be measured in terms of judgment and opinion.

The second reason why judgment will play a large part in vocational psychology is that judgment enters at some stage into the construction of every vocational test. In the development of tests by any of the methods in current use, they must be standardized upon a group of people who are *judged* to be good, medium and poor in the trait in question. Those tests are diagnostic which are well done by the people *judged* to be good, poorly done by the people *judged* to be poor, etc. The standardized tests cannot be better than the judgments on which they are based. Even in the development of the intelligence test, which has come to be treated as a rather objective measure, judgment enters at many points. To quote from Thorndike:¹

Our present measurements of intelligence rest on human judgments of value, judgments that product A is "better" or "truer" or "more correct" than product B, that method C is "preferable" to method D, or that C is "right," while D is "wrong," and the like.

In some cases this is so clear that everyone must admit it. Thus in three of our best tests of intelligence, giving the opposites of words, completing sentences by supplying omitted words, and answering questions about a paragraph read, we make elaborate keys assigning credits to the different responses. These keys are obviously made by human judgment of the value of each response.

The credits given may represent valuations by the truthfulness or wisdom of the answers or sentences, by their grammatical form, by their rhetorical excellence, by their originality, by the rate of producing them, or by a subtle sense of their significance as evidence of intelligence.

¹ E. L. Thorndike, "Measurement of Intelligence," *Psychological Review*, Vol. XXXI (1924), pp. 219 ff.

In some cases the value is assigned so easily that we may thoughtlessly assume that the response indicates intelligence regardless of any process of evaluation. For example, we may consider that in a test in arithmetical computation or problem solving, the right answers are signs of intelligence regardless of what anybody thinks. A little thought will convince us, however, that in such tests the human judgment acts as truly as in a Completion or Paragraph-reading test. The main difference is that, having once for all decided that right answers are better than wrong answers, we do not raise the issue about any particular answer. We simply assume or make a general rule of valuation. The valuation becomes obvious if we collect all the responses made to an arithmetical task and ask whether all the different "rights" are equally good or right, and whether all the different "wrongs" are equally undesirable.

Since, therefore, judgment is a necessary tool, not only in the measurement of those functions for which tests cannot be devised, but also in the construction of our most objective tests, it is important to know the conditions under which judgments will have the highest degree of reliability. It will be important to find out also how these reliable judgments can be most readily obtained for practical vocational purposes. The process of evaluation by means of judgments is not essentially different from objective measurement. Judgments such as "This is more," "That is better," "I prefer this one," all imply measurement of a very crude sort in terms of relative position or relative amount. This type of evaluation forms the basis for the "Order of Merit Method" of measurement so extensively used in psychological work and its applications to vocational problems. The various forms in which these judgments may be made will be considered in this chapter.

VARIATION AMONG INDIVIDUAL JUDGMENTS

The most significant characteristic of judgment or opinion is its variation from person to person. The reason for this

is to be found in the fact that the outcome of the judgment depends not only upon the object or person or trait being judged, but also upon the characteristics of the judge himself. It is, for example, quite conceivable that the neatness of an individual will be estimated very differently by one who is exceedingly neat and by one who is exceedingly slovenly, while, of course, the object of the judgment remains the same. Such differences among the judges in reacting to the same situation are usually but mistakenly called "errors." On account of these variations introduced through the individuality of the judge, it is seldom if ever safe to rely on the judgment of one person in vocational measurement. There is the danger that the judgment will be too strongly colored by the personality of the judge. When the opinions of a number of judges are combined by the proper statistical methods, the peculiarities of the individual judgments are ironed out. This is certainly the case when the "errors" thus introduced are "accidental" or variable errors, that is, when any one of them taken at random is just as likely to result in overevaluation as underevaluation of the trait. In such a case the "error" of some judges will be offset by the "error" of other judges in the opposite direction, with the result that the consensus of opinion of all will give a measure more nearly correct than that of any individual judge taken at random.

In experimental studies where there is some objective measure against which to check the results of judgment, the greater validity of the consensus of opinion is evident. In a study of the diagnostic value of letters of application,² the coefficients of correlation between the judgments made by eleven individuals and the criterion are as follows, all of them being positive :

² A. T. Poffenberger and V. H. Vartanian, "The Letter of Application in Vocational Selection," *Journal of Applied Psychology*, Vol. VI (1922), pp. 74 ff.

.24, .30, .34, .38, .40, .46, .49, .49, .53, .56, .57

The average of these coefficients is .44. But the correlation of the consensus of opinion of the eleven judges with the criterion is .56. Thus there is only one judge who gives a better result than the group taken as a whole. Similar figures could be cited from a number of studies of judgment. One of the most interesting cases is presented in Table XXIV.³ A series of five advertisements were judged for their relative persuasiveness by ten judges. Their value was also measured in terms of actual returns from their use. Although no one of the ten judges gave an order of persuasiveness that was correct, the consensus of opinion of these judges gave an order that agreed exactly with the order of value of these advertisements measured in terms of returns.

TABLE XXIV. THE VALIDITY OF A CONSENSUS OF OPINION

ADVERTISEMENT	REACTIONS OF TEN JUDGES										AVE.	ORDER OF VALUE	
												Test	Returns
A	4	3	2	3	2	3	4	4	4	1	3.0	4	4
B	5	5	1	4	5	1	1	1	1	2	2.6	2	2
C	1	1	3	1	4	2	2	2	3	4	2.3	1	1
D	2	4	5	5	3	5	5	5	5	5	4.4	5	5
E	3	2	4	2	1	4	3	3	2	3	2.7	3	3

The dependence upon one judge in the practice of vocational work lays the whole procedure open to criticism. The individual reactions to letters of application, letters of recommendation, personal interviews, etc., are subject to a variety of errors due to personal idiosyncrasies, likes and dislikes, changing moods and feelings of the judge. No

³H. L. Hollingworth, *Advertising and Selling* (D. Appleton and Co., New York, 1913), p. 9.

single change in employment procedure will bring about so much improvement as the recognition of individual differences in judgment and the need for a consensus of opinion. And yet serious practical difficulties are often encountered in satisfying this requirement for safe judgments. For example, in a department store the evaluation of the characteristics of sales people and clerical workers frequently must rest upon the judgment of one buyer or department head who is the only person in a position to judge. In the public school system, too, it is very difficult to get more than one or probably two superiors who are capable of judging the qualities of a group of teachers. From the studies of the reliability of judgment which are available, it would seem that three independent estimates of the traits commonly judged is the minimum requirement for satisfactory work. In many cases the number should be very much larger.

CONSTANT ERRORS OF JUDGMENT

The "errors" made by individual judges are not always of this accidental sort. Sometimes they are "constant errors," that is, there is some influence at work which tends to make the judges err in the same direction. It is evident that, in such a case, increasing the number of judges will not eliminate the "error." For example, in an unpublished study by the writer, the relative intelligence of fifteen men was judged from their photographs. It was also measured by means of one of the best intelligence tests. The relationship between the order of intelligence determined in these two ways was found to be negative. The greater the actual intelligence was, the less did the estimated intelligence appear to be. When the number of judges was increased the negative relationship became more and more pronounced. There was a "constant error" present, which turned out upon investigation to be due to the confusion on the part of the judges of "good-looking" with intelligent. In most practical

circumstances in which judgments are employed there is no actual or correct measure against which to check the judgments. Therefore, it is important to discover as far as possible the presence of "constant errors" that might distort the measurements in the way just demonstrated in order that some device may be adapted to avoid them.

A further fact about "constant errors" should be noted, namely, that not all of them distort the evaluation. Take, for example, the opinions of 25 judges concerning the relative size of a certain area which was actually fifth in size in a series of ten specimens. These opinions placed the object in the following positions:

7, 4, 6, 5, 3, 1, 2, 6, 3, 3, 3, 9, 3, 4, 4, 2, 6, 3, 9, 7, 2, 4, 3, 4, 5,

It will be observed that 16 of these 25 judges rated the area larger than it really was (1 indicating largest and 10 smallest), seven rated it smaller and two judgments were correct. There was at work in these judgments a "constant error," an optical illusion due to the shape of the figure, which made it appear larger than it really was. Although this "constant error" creates a discrepancy between the physical measure and the judgment measure, for certain practical purposes the judgment measure may be the correct one. In such a case it would be a mistake to attempt to eliminate the "error." For instance, if an attempt was being made to find that container for a food product which for a given actual content would look the largest, it would be defeating the purpose of the test to eliminate the illusion of size. Likewise, if one were attempting to measure cheerfulness, the judgment might well give a more valid measure than some complicated measure of glandular or other physiological activity, since the result desired is the *impression* of cheerfulness created by the person upon others.

One of the most frequent sources of the kind of "constant

error" that should be avoided is the so-called "halo" ⁴ effect or atmosphere about an individual which may influence one's judgment of him in respect to any trait whatsoever. Our general impression of a person is likely to color all our judgments of his particular traits. Thorndike and others have shown by the correlation method that all traits in an individual have a much closer apparent relationship than they could actually have. On account of this "halo" effect, many judgments of specific personality traits turn out to be nothing more than measures of a general impression created by the individual. A clear understanding of the nature of this "error" is essential in dealing properly with it. The influence of the personal appearance of a person upon the estimation of his intelligence in the case described is a good illustration of the distortion of judgment due to this cause.

WHAT CONSTITUTES A GOOD JUDGE?

The fact that individuals differ so much among themselves in their judgments of personality traits and that a part at least of such differences is due to the characteristics of the judge himself raises the question as to what constitutes a good judge. Although the data at present available on the question of the factors affecting judgment are meager, it appears that not only do individuals differ in the quality of their judgment of a given trait, but that the same individual differs in the quality of his judgment of different traits. Thus the ability to judge appears to be a highly specialized function within the individual. Table XXV ⁵ contains material that shows clearly both these types of variation. The figures are in terms of coefficients of correlation be-

⁴E. L. Thorndike, "A Constant Error in Psychological Ratings," *Journal of Applied Psychology*, Vol. IV (1920), pp. 25 ff.

⁵The best survey of this material is to be found in H. L. Hollingworth, *Judging Human Character* (D. Appleton and Co., New York, 1922).

TABLE XXV. INDIVIDUAL DIFFERENCES IN THE QUALITY OF JUDGMENT

Judge	Intelligence	Neatness	Sociability
A	.51	.11	.39
B	.11	.10	.08
C	.15	.29	.05
D	.27	.06	.49
E	.08	.24	.08
F	.43	.41	.28
G	.04	.11	.02
H	.39	.09	.32
I	.22	.08	.00
J	.30	.02	.55

tween an individual's judgment of twenty-five people and the consensus of opinion about these twenty-five people (which is taken as the correct measure in this study). The coefficients for ten judges concerning the three traits, Intelligence, Neatness and Sociability, are presented. Reading down any one column will disclose the degree to which the judges differed one from the other in their estimation of the trait named at the head of the column; reading across the page will show how the individual judge varied in ability to estimate the three different traits. For instance, the relationship between the estimate and the criterion for Intelligence varies for the different judges from $-.27$ to $+.51$, while for judge D the coefficients for the three traits vary from $-.27$ to $+.49$.

It is logical to assume that to be a good judge of a trait in others one should possess that trait to a high degree, or that within certain limits the more of a trait one possessed the better judge he would be of that trait. In organizations where there is no highly developed employment or personnel department, the applicants for a given work are selected by the experts in that line of work. Where selections are made strictly by an employment office, it is done not so much

TABLE XXVI. RELATION BETWEEN THE POSSESSION OF A TRAIT AND THE ABILITY TO JUDGE IT

Neatness	.22
Intelligence	.49
Humor	.59
Conceit	.19
Beauty	.23
Vulgarity	— .24
Snobbishness	.33
Refinement	.38
Sociability	.48

through a lack of confidence in the expert as a judge as it is to bring about a centralization of function. Although a matter of great practical importance is involved, there is little experimental evidence at hand. One bit of data may be obtained from Hollingworth⁶ in terms of the correlation between the possession of a trait and the ability to judge that trait within a group of twenty-five people. The figures are given in Table XXVI for a series of nine traits. All the coefficients except one are positive although many of them are very small. In fact, none is so high as to justify the choice of a judge for a given purpose solely on the basis of his possession of the trait to be judged. This point is far more significant than the differences that obtain among the various traits. One might well expect that intelligence would be a potent factor in the quality of judgments that could be made. The data that are available show that the possession of intelligence does not make one an especially good judge of the intelligence of others, although intelligence gives the next to the highest correlation in the table. It is doubtful, indeed, if the possession of intelligence would be a more potent factor in judging other traits than it is in judging intelligence itself.

⁶H. L. Hollingworth, *Vocational Psychology* (D. Appleton and Co., New York, 1916), p. 160.

DEGREE OF ACQUAINTANCE AND QUALITY OF JUDGMENT

A certain degree of acquaintance with the person to be judged would seem to be a requisite of good judgment. This is true except in those instances where the estimate of first impression is desired, as possibly in some highly social occupations. In the absence of such acquaintance, the judge must rely upon the indicators and clues which are so generally condemned when employed by the character analyst. Such a degree of acquaintance is essential as will enable the judge to know and evaluate the particular trait to be measured. The matter is not so simple, however, as it seems at first, since too close an acquaintance introduces errors of judgment which differ from but are quite as potent as those resulting from too slight acquaintance. The atmosphere created by close friendship or by prejudice either favorable or unfavorable is very likely to warp the judgment. Slawson⁷ finds, by the use of the partial correlation technique, that in the long run degree of acquaintance makes no significant difference in the quality of judgments of personality. His conclusion, however, is significant:

This inability of acquaintance to definitely either raise or lower judicial agreement becomes evident upon considering the several ways in which this factor may operate. For although lack of acquaintance with one or several subjects may result in chance ratings, thus lowering the correlation between the unacquainted judge and the rest of the group of judges, intimate acquaintance between a rater and subjects may also lower the correlation between the intimately acquainted judge and the rest of the judges, by the exercise of prejudice either due to friendship or to the discovery of peculiarities in the subject which are particularly abhorrent to the rater (and probably unknown to the less intimately acquainted judges). The positive and negative

⁷J. Slawson, "The Reliability of Judgments of Personal Traits," *Journal of Applied Psychology*, Vol. VI (1922), p. 161.

influences would then in the long run tend to balance each other, that is, acquaintance would have little or no effect. This finding is, of course, no argument in favor of phrenology, because zero acquaintance was eliminated before we started by choosing as judges those who had at least some acquaintance with the subjects. The discussion refers only to relative degree of acquaintance and not to a total lack.

It is clear from this statement that judgments about individuals are warped by the degree of acquaintance and that it is only in the group as a whole that the errors due to too close and too slight acquaintance are ruled out. In most, if not all, aspects of vocational guidance and selection interest is directed toward the individual and what judgments of value will do to him. Knight,⁸ using a different technique from that of Slawson, shows plainly the influence of degree of acquaintance upon the judgment in particular cases. He studied grades assigned by the judgment method to 1,048 teachers. The degree of acquaintance between the judges and teachers ranged from less than one year to more than eight years. He finds that if the difference in acquaintance is a matter of minutes, hours or weeks, the greater the degree of acquaintance, the better the judgment, but when it is a matter of years, the reverse relation holds. The author concludes:

The factor of acquaintance, then, operates to make ratings more lenient, i.e., to increase the over-rating, and to make ratings less critical and less analytical, i.e., increases the influence of the halo of general estimate. It is in the direction of truth to discount the ratings of judges when acquaintance has been long. In a way it is literally true to say of a judge's estimate: "His judgment is of doubtful validity *because* he has known his man too long."

⁸ F. B. Knight, "The Effect of the 'Acquaintance Factor' upon Personal Judgments," *Journal of Educational Psychology*, Vol. XIV (1923), pp. 129 ff.

WHAT TRAITS CAN BE JUDGED?

The fundamental propositions concerning measurement, namely, "whatever exists must exist in some amount," and "whatever exists in any amount can be measured," will apply to characteristics of the personality as well as elsewhere. A third obvious proposition might be added to the effect that "measurement presupposes a recognition of what is to be measured." In the field of judgment a lack of clear recognition of what is being measured is evident everywhere and is responsible for much confusion. For instance, "Personal Appearance" is frequently judged with no specifications or definition as to just what is to be included in the trait. Is it physical form, character of wearing apparel, neatness, or manner? Shall financial considerations be given weight, shall social status or occupation be taken into account? What judge could be expected to know just what the following names signify, and what is the chance of getting different people to agree on what to look for in judging them?

Accuracy

Activity

Affability

Aggressiveness

Alertness

Ambition

Analytical Ability

Artistic Ability

Attention

Attractiveness

These are the first ten of a list of 193 traits, presented without definition, to be used in vocational guidance. It is essential that a trait to be judged should be defined so as to be thoroughly comprehended by the judge and so that different judges can agree in their understanding of it.

We may now inquire whether all traits that can be defined are equally easy to judge, or are judged with equal reliability. This is a difficult question to answer because of the absence of any criterion which is not itself derived

from judgment. The degree of agreement among a group of judges is usually taken as the indicator of the ease and reliability of judging. It follows directly from the choice of this indicator that those traits are easiest to measure in terms of judgment which have the most objective manifestations, for all judges would have the same objective products on which to base their judgments. On the other hand, those characteristics which show themselves only in a social way, i. e., in the interaction of individuals, are less reliably judged, because the reaction of each judge depends in part upon his own personality. Hollingworth⁹ has arranged twenty-four traits in the order of the reliability with which they can be judged. If these are divided into four groups, so that Group I stands for greatest reliability, and Group IV for least reliability, the groups will also represent differing degrees of objectivity. The traits in the first group have the most definite objective manifestations and those in the fourth group have the least definite objective records. The groups are as follows:

<i>Group I</i>	<i>Group II</i>	<i>Group III</i>	<i>Group IV</i>
Efficiency	Perseverance	Clearness	Usefulness
Originality	Judgment	Mental Balance	Integrity
Quickness	Will	Intensity	Coöperative-
Intellect	Breadth	Reasonableness	ness
	Leadership	Independence	Cheerfulness
		Refinement	Kindliness
		Physical Health	
		Emotions	
		Energy	
		Courage	

The degrees of objectivity may vary considerably with the circumstances in which the judgments are made, hence degree of reliability may vary likewise. For example, Coöperative-

⁹ H. L. Hollingworth, *Vocational Psychology* (D. Appleton and Co., New York, 1916), p. 139.

ness, a trait which stands in the least objective of Hollingworth's groups, was measured for reliability by Slawson¹⁹ among five other traits in the case of the teachers in six different schools. Its relative position among the six traits was for the different schools as follows:

<i>School</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>	<i>VI</i>
	3.5	5.0	1.0	4.5	5.0	3.5

These figures mean that, while for one group of teachers Coöperativeness was the trait most reliably judged, for another group it was the least reliably judged. The objectivity of a character trait or the degree of agreement to be expected in judging it, is itself a variable quantity. The more objective the manifestations of a trait are, the more susceptible it is to measurement by objective test, hence it follows that the very traits which are hardest to judge, namely, the least objective, are the very ones that will have to be measured in terms of judgment.

STABILITY OF CHARACTER TRAITS

How stable are the traits which we are called upon to judge? This question is treated at considerable length in Chapter XVII. It will suffice here to say that the stability of a trait is usually inferred from the stability of the judgments of the trait in the same individual, since any more objective measure of the trait is lacking. If the estimates of traits are repeated at intervals of several months, or at least long enough to eliminate the influence of memory of earlier estimates, stability may be calculated in terms of the uniformity of judgment over this interval of time. Such a measure will tell nothing about the correctness of the judgment, but will indicate merely the degree of permanence of the criteria of the judgments. These measures reflect also

¹⁹ J. Slawson, "The Reliability of Judgments of Personal Traits," *Journal of Applied Psychology*, Vol. VI (1922), p. 161.

the influence of fluctuations in the judge as well as the variations in the trait itself. In terms of coefficients of correlation, the relationship between two such series of judgments has been found to vary from $+.60$ to $+.80$. As might be expected, the stability of the trait varies with the judge, the correlations in one study for different judges varying from $+.20$ to $+.90$.

RATING SCALES

The order of merit method of measurement, which consists essentially in deciding that one object of judgment is "more" or is "less" than another one in some respect, is the most valid that can be employed in vocational work where judgments are involved. Obviously the method, which presupposes two or more objects which can be arranged in an order, is not adapted for all vocational purposes. For it often happens that there is only one person to be evaluated for a given job, in which case the method of relative position cannot be employed. This difficulty is overcome by the use of rating scales of various forms, each providing a series of items among which the new one shall be given a standing or rating. Since the items or units or objects forming the scale can have their positions determined once for all, it is only necessary to note where the new item falls in the series and read off its value directly, just as is done in measuring the length of an object against a footrule. The rating scales are valid according to the degree to which they approach the order of merit method in principle. They differ mainly in the character of the units of which the scale is composed.

In the Man to Man Rating Scale there is the closest approach to the order of merit measurement because the man to be measured is evaluated along with other men. The units of the scale are persons known to the judge and chosen by him as possessing specified degrees of the trait to be

measured. The rating scale for the trait Leadership¹¹ as used in the personnel system of the United States Army will serve as an illustration :

<i>Leadership</i>	<i>Score</i>
Initiative, force, self-reliance, decisiveness, tact, ability to inspire men and to command their obedience, loyalty and coöperation.	Highest 15
	High 12
	Middle 9
	Low 6
	Lowest 3

In the first blank space is to be written the name of the officer possessing the highest degree of leadership known to the judge; in the last space, that one possessing the lowest degree of leadership known to the judge; in the middle space, that one who stands in leadership about midway between the two first chosen. The spaces marked "High" and "Low" are for men whose leadership ranks about halfway between the middle man and the highest and the middle man and the lowest respectively. The ratings given an officer on this scale are, therefore, in terms of their standing among these men. This standing may then be transformed into the numerical units shown at the right of the scale. Certain difficulties arise in the practical use of this scale, from the fact that each judge has to construct his own scale, that is, he must furnish the men to occupy the various steps on the scale. First, it is not easy to find suitable specimens without more study than one is willing to give the task. And second, since valid judgments imply the consensus of opinion of a number of judges, the scales of all the judges should be equivalent. If all judges could use the same persons for the different positions on the scales they would be comparable, but such agreement is practically never attained. If the scales are not thus comparable, the measures obtained from

¹¹ This scale is described in detail in *The Personnel System of the United States Army*, Vol. II (1919), pp. 252 ff.

the different judges cannot be combined legitimately, hence consensus of opinion is impossible.¹²

A scale that might be called the "Specific Instance Scale" is much simpler to construct and use than the "Man to Man Scale," although it departs farther from the order of merit method. Such a scale contains units which are the same, objectively at least, for all judges. Instead of being men possessing a given trait to a specified degree, they are specific instances of behavior representing various degrees of the trait. A sample¹³ of such a scale for measuring sense of humor is given below. It happens that in this particular specimen the measuring is done by checking a point on the scale line, but a numerical scale could just as readily be used.

SENSE OF HUMOR

Sees the funny side of everything.	Usually sees the funny side of things.	Slow in response to comic.	Often has to have jokes explained to him.	Takes everything literally.
------------------------------------	--	----------------------------	---	-----------------------------

This scale resembles in its form and use the handwriting, drawing, composition and other product scales in common use in educational work, and has much to commend it. One difficulty arises from the necessity of having several instances of behavior at each point on the scale, so that there may be samples adequate for gauging the quality of every person to be measured. The difficulty here, however, is no greater than that encountered in the construction of educational scales. Care must be exercised to make the instances sufficiently specific to avoid the necessity for interpretation on the

¹² For a critical examination of this scale, see H. Rugg, "Is the Rating of Human Character Practicable?" *Journal of Educational Psychology*, Vols. XII and XIII (1921, 1922).

¹³ M. Freyd, "The Graphic Rating Scale," *Journal of Educational Psychology*, Vol. XIV (1923), p. 83.

part of the judge. If this precaution is observed, there should be fairly close agreement among the judges as to their meaning.

To another very commonly used scale the name "Descriptive Term Scale" may be applied. Its units consist of such terms as "very," "average," "slightly," "rather," "most," etc. Such a scale is very easy to make, and very easy for the uncritical judge to use, but it bears little resemblance to the order of merit method of measurement. Such a scale for "Originality" is given below:

ORIGINALITY

<i>Above the Average</i>			<i>Below the Average</i>		
Markedly	Distinctly	Doubtful	Doubtful	Distinctly	Markedly

A serious objection to this and similar scales is the vagueness of meaning of the scale units, and the consequent danger that they will not be interpreted in a similar fashion by different judges, with the result that the scales will not be comparable. Scales constructed in this fashion have little to commend them for serious use.

An interesting combination of the last two scales is used by Rugg¹⁴ in which a person is rated on a scale of three units, Low, Average and High, for a number of specific instances of behavior. His scale for "Team Work" is reproduced on the following page.

This type of scale offsets the admittedly crude unit of measure with a large number of reactions. It has the advantage of forestalling misinterpretation by the specific character of the questions, and the simple threefold classification called for makes the task of the individual judge easy and the ratings of the different judges practically comparable.

¹⁴H. Rugg, "Is the Rating of Human Character Practicable?" *Journal of Educational Psychology*, Vols. XII and XIII (1921, 1922).

RUGG'S SCALE FOR TEAM WORK QUALITIES

<i>To what extent:</i>	<i>Low</i>	<i>Average</i>	<i>High</i>
1. Does he coöperate with other teachers in school activities?.....			
2. Does he contribute to faculty meetings?			
3. Is he loyal to administration and to other teachers?.....			
4. Does he suggest plans for group improvement of the school?.....			
5. Does he shoulder responsibility for his own acts?.....			
6. Do pupils go to him voluntarily for advice and conference?.....			
7. Does he go out of his way to advise and help students?.....			
8. Does he acquaint himself with pupils' home conditions where it is wise?..			
9. Does he participate in community activities outside the school?.....			
10. Are his records and reports in on time and in complete form?.....			
Summary Rating.....			

Perhaps the simplest scale that has been used is the numerical scale with the maximum amount of the trait represented at one end and the minimum amount at the other. The total range is then divided into arbitrary units. An unique specimen of this sort for measuring Carefulness is shown below:

"Out of 100 chances to display the characteristic of Carefulness how many times will it be shown? If one is careful 95 per cent of the time, mark the 95 per cent point on the scale, etc."

Carefulness.. 0 10 20 30 40 50 60 70 80 90 100

Such judgments as this scale calls for involve a sort of speculation which might offer considerable difficulty to a conscientious judge. The definiteness of the meaning of the units is only apparent. There is always danger of taking the numerical score derived from the use of such a scale entirely too seriously.

A graphic rating scale for clerical workers which is reported to be in actual service¹⁵ is reproduced on page 294. The instructions for using it are as follows:

Instruction for making out this report: Before attempting to report on this employee it is necessary to have clearly in mind the definitions of the qualities which are to be reported upon. In each quality judge this employee and place an X somewhere on the line running from right to left that will indicate approximately this employee's standing in that quality. It is not necessary to put the X directly above any of the division points. Judge employee on present job only wherever possible.

In this scale the various characteristics are given weights according to their relative importance in clerical work, as judged by executives. The values for individual work and for supervisory work are as follows:

	I	II	III	IV	V	VI	VII	VIII
Individual Work	10	20	25	10	20	7.5	7.5	0
Supervisory Work	10	20	10	10	5	10	10	25

It will be observed from these figures that accuracy is two and a half times as important as appearance for the individual worker and that appearance is twice as impor-

¹⁵ M. A. Bills, "A Method for Classifying Jobs and Rating the Efficiency of Clerical Workers," *Journal of Personnel Research*, Vol. I (1922), pp. 384 ff.

GRAPHIC RATING SCALE FOR CLERICAL WORKERS

I. APPEARANCE. Consider neatness of person and dress	Appropriate	Neat	Ordinary	Passable	Slovenly
II. ABILITY TO LEARN. Consider ease of learning new methods	Very Quick	Catches on Easily	Needs Repeated Instruction		
III. ACCURACY. Consider quality of work, freedom from errors	No Errors	Very Careful	Few Errors	Careless	Many Errors
IV. DEPENDABILITY. Consider how well he can be relied on to do his work without supervision	Very Reliable	Trustworthy	Usually Reliable	Unreliable	
V. SPEED. Consider amount of work accomplished	Very Rapid	Rapid	Moderate	Slow	Very Slow
VI. COÖPERATIVENESS. Consider his ability to work with others	Coöperative	Falls in Line	Difficult to Handle	Obstructive	
VII. CONSTRUCTIVE THINKING. Consider his ability to grasp a situation and draw the correct conclusions	Shows Originality	Resourceful	Carries Out Suggestions	Needs Detailed Instruction	
VIII. ABILITY TO DIRECT WORK OF OTHERS. Consider ability to direct work and gain coöperation	Gets Maximum Efficiency	Directs Work Without Friction	Secures Limited Coöperation	Wastes Manpower	Antagonizes

tant as speed for the supervisor. Other interesting comparisons may be noted.

Whatever rating method is used, the following conditions must be satisfied in addition to all the other requirements of good judgment previously discussed:

1. There should be at least three independent ratings.
2. The scales used by the different judges should be comparable and equivalent.
3. A sufficient degree of acquaintance with the person judged is presupposed.
4. Precautions must be taken to minimize the "halo." The first three have been dealt with sufficiently. Two means have been offered for reducing the "halo" effect in rating scales. Freyd¹⁶ offers an extremely simple remedy, to be used where the rating scale is in the form of a line. It consists in sometimes having the "good" or "desirable" end of the scale at the right and sometimes at the left. This shift of base seems to break up any tendency to check the lines always toward the right or left, and calls for more careful reaction to each trait separately. Thorndike's¹⁷ remedy adds considerable complication to the rating process, but unless a simpler method is found adequate, should be used where accurate ratings are desired. "In all work on ratings for qualities the observer should report *evidence*, not a rating, and the rating should be given on the evidence to each quality separately without knowledge of the evidence concerning any other quality in the same individual."

In spite of all the difficulties involved in the judgment process and all the errors to which it is subject, the following paragraph quoted from Hollingworth¹⁸ clearly

¹⁶ M. Freyd, "The Graphic Rating Scale," *Journal of Educational Psychology*, Vol. XIV (1923), pp. 83 ff.

¹⁷ E. L. Thorndike, "A Constant Error in Psychological Ratings," *Journal of Applied Psychology*, Vol. IV (1920), pp. 25 ff.

¹⁸ H. L. Hollingworth, *Vocational Psychology* (D. Appleton and Co., New York, 1916), p. 148.

describes the situation as far as the rôle of judgment concerns vocational psychology:

These judgments variable as they are constitute as valid a measurement as it is possible to secure under the circumstances. They (the traits judged) are not to be conceived as substances of which the different individuals possess different amounts. These traits represent mainly ways of behaving or ways of impressing our neighbors. No better measure of them exists than the actual statement of what this impression is. Just as the value of a commodity depends entirely on what people can be persuaded to pay for it, so the beauty, conceit, neatness, etc., of an individual are mainly constituted by the kind of impression the individual makes upon those about him. At least we may be sure that only to the degree that such traits actually manifest themselves and thus determine the reactions of others toward the individual concerned, only to that degree do the traits have vocational significance.

CHAPTER XVI

THE MEASUREMENT OF GENERAL AND SPECIAL CAPACITY

THE intelligence test is the most commonly used of all the devices for vocational measurement. Aside from the fact that it was the first and most convenient measuring tool that offered any hope of being serviceable, there underlies its use the popular belief, implied if not explicitly stated, that some general quality, intelligence, is an indispensable requirement for success in any vocational activity. Other special requirements are recognized as supplementary and secondary in importance. The most widely adopted definition of intelligence supports this belief. It is defined as all-around competence, or as a kind of average of all the abilities of learning, thinking and acting. Concerning the vocational value of intelligence tests, Terman¹ said about ten years ago that the time was not far distant when intelligence tests would become a recognized and widely used instrument for determining vocational fitness. He did not claim that tests were available which would tell us unerringly exactly what one of a thousand or more occupations a given individual is best fitted to pursue. But he predicted that when thousands of children who have been tested by the Binet-Simon scale have been followed out into the industrial world, and their success in various occupations noted, we shall know fairly definitely the vocational significance of any given degree of mental inferiority or superiority.

¹L. M. Terman, *The Measurement of Intelligence* (Houghton Mifflin Co., New York), p. 17.

Even if a definition of intelligence such as that just given be accepted, the value of its measurement for vocational uses will still depend on the nature of the intelligence test. The best known tests comprise a varied battery of tasks that would seem to measure general, all-around competence. The question has been raised many times, however, as to whether the tests as at present constructed do measure a sufficiently varied assortment of functions to conform to the definition. The following quotation from Thorndike² bears upon this question:

"Presumably a man can use intellect and display the amount of it which he possesses in operations with any sort of material object, any living plant or animal, including himself, any quality or relation that exists in reality or imagination, any idea or emotion or act. Our tests might draw upon anything for their material. . . . They have, in fact, greatly favored words, numbers, space-forms, pictures, neglecting three-dimensional objects and situations containing other human beings."

There have been several reasons for thus restricting intelligence test material. The Binet-Simon tests were first devised for measuring school children in order that they might be more properly adjusted to their work, hence what would be more natural than to measure them by means of the symbols which are the tools with which they work? Even to-day the intelligence tests find their widest application in the field of education. The original form in which the tests were developed has largely influenced their subsequent character. The individual intelligence examinations first used in America were almost direct translations from the French. Again, these same tools are far more convenient to handle in test form than concrete objects would be. They alone make possible the printed test blank. No less than a roomful

²E. L. Thorndike, "The Measurement of Intelligence," *Psychological Review*, Vol. XXXI (1924), pp. 237 f.

of concrete objects could adequately replace the usual paper and pencil test. This has been discovered in the effort to construct tests of mechanical ability. A third reason is to be found in the idea that it takes a higher grade of intellect to deal with symbols, abstractions, general notions, etc., than with concrete objects and particular situations, and that a test which is to cover any considerable range of intelligence must be of the abstract sort.

On the other hand, the belief is growing that intelligence may be more specialized than has been assumed and that symbol tests will not therefore measure all persons with equal fairness. Just how far this specialization of intellect goes is purely a matter of speculation at present. But three specialized forms which intelligence may take have received some consideration and attempts have been made to measure them by means of tests. They are the abstract intelligence, or the capacity to deal with symbols, abstract ideas, etc.; mechanical intelligence, or the capacity to deal with concrete objects; and social intelligence, or the capacity to deal with other human beings.

Coupled with this growing belief in specialization of intelligence is the recognition that opportunity and training influence the facility with which one's intelligence may operate. The danger of measuring the intelligence of all people with one test of the sort at present in use, is, therefore, that it may not measure all kinds of intelligence equally well, and that a considerable advantage may lie with those persons whose experience has been mainly with symbols and abstractions. For instance, it was discovered in the survey of the intelligence of different occupational groups in the United States Army that clerical workers had a considerably higher intelligence-standing than tool makers, machinists and general mechanics. Is the advantage of the former due to the fact that the test measured their particular kind of intelligence rather than the kind possessed by the latter, or is it

possibly due to the fact that the test presented familiar and customary situations to the former and strange and unusual situations to the latter? It is well to keep such possible sources of error in mind in the use of current intelligence tests for vocational purposes, especially in comparing the intelligence of one occupational group with that of another group.

The portions of a typical and widely used intelligence examination³ which are reproduced below will illustrate the nature of these tests. This one consists of 75 items, and is of the self-administering type, that is, it may be taken and scored by any person without the supervision of an examiner.

This is a test to see how well you can think. It contains questions of different kinds. Here is a sample question already answered correctly. Notice how the question is answered:

Which one of the five words below tells what an apple is?

1 flower, 2 tree, 3 vegetable, 4 fruit, 5 animal.....(4)

The right answer, of course, is "fruit"; so the word "fruit" is underlined. And the word "fruit" is No. 4; so a figure 4 is placed in the parentheses at the end of the dotted line. This is the way you are to answer the questions.

EXAMINATION BEGINS HERE:

1. The opposite of hate is (?)
1 enemy, 2 fear, 3 love, 4 friend, 5 joy.....()
2. If 3 pencils cost 5 cents, how many pencils can be
bought for 50 cents?()
3. A bird does not always have (?)
1 wings, 2 eyes, 3 feathers, 4 a nest, 5 a bill....()
4. The opposite of honor is (?)
1 glory, 2 disgrace, 3 cowardice, 4 fear, 5 defeat.()

³ From Otis, *Self-Administering Test of Mental Ability*, "Higher Examination—Form A," copyright 1922, by World Book Company, Yonkers, New York.

5. A fox most resembles a (?)
 1 wolf, 2 goat, 3 pig, 4 tiger, 5 cat.....()
34. Of the five things below, four are alike in a certain way. Which is the one not like these four?
 1 smuggle, 2 steal, 3 bribe, 4 cheat, 5 sell.....()
35. If 10 boxes full of apples weigh 400 pounds, and each box when empty weighs 4 pounds, how much do all the apples weigh?()
36. The opposite of hope is (?)
 1 faith, 2 misery, 3 sorrow, 4 despair, 5 hate.....()
37. If all the odd-numbered letters in the alphabet were crossed out, what would be the tenth letter not crossed out? Print it. *Do not mark the alphabet*.....()
 ABCDEFGHIJKLMNOPQRSTUVWXYZ
38. What letter in the word SUPERFLUOUS is the same number in the word (counting from the beginning) as it is in the alphabet? Print it.....()
71. A man who is influenced in making a decision by pre-conceived opinions is said to be (?)
 1 influential, 2 prejudiced, 3 hypocritical, 4 decisive, 5 impartial()
72. A hotel serves a mixture of 2 parts cream and 3 parts milk. How many pints of cream will it take to make 15 pints of the mixture?.....()
73. What is related to blood as physics is to motion?
 1 temperature, 2 veins, 3 body, 4 physiology, 5 geography()
74. A statement the meaning of which is not definite is said to be (?)
 1 erroneous, 2 doubtful, 3 ambiguous, 4 distorted, 5 hypothetical()
75. If a wire 20 inches long is to be cut so that one piece is $\frac{2}{3}$ as long as the other piece, how long must the shorter piece be?()

THE MEASUREMENT OF MINIMUM INTELLIGENCE REQUIREMENTS

A certain minimum of general capacity, or intelligence, is a prerequisite for success in any occupation. There can be

no doubt about this in the mind of any thoughtful person if he will think of the extreme cases. The most important service that intelligence tests can render is to establish this minimum intelligence level for as many occupations as possible. The tests are most commonly used for this purpose both in education and in vocational selection and guidance. Success in high school work demands a given minimum intelligence and success in college work also demands a given minimum intelligence higher than the former, the manner in which this minimum is stated being dependent upon the test used. Tentative limits have been set likewise in certain manual, clerical and selling occupations. The implication in all these cases is that one who does not possess at least this amount of intelligence cannot survive in the occupation.

The method of establishing such occupational "dead lines" is illustrated in Figure 22.⁴ This is a scatter diagram showing the relation between success in school work and score on the familiar Sentence Completion test. The vertical scale consisting of ten steps represents degrees of success in school work measured in terms of the consensus of opinion of instructors, while the horizontal scale indicates score in the test, and extends from 21 to 91 points of credit. Each dot on the chart represents one student. By locating a given individual on the horizontal scale, his standing in the test will be known, and by locating his position on the vertical scale, his standing in school will be known. Thus the poorest individual in the test (lower left corner of the chart) made a test score of 23 and stood in the next-to-the-poorest tenth of the student group. If one wished to raise the standard of the school so that no student below the present average could be admitted, the "dead line" would have to be placed at 84 (upper critical score). A more feasible "critical score" is one set at such a point that all students who get less than

⁴ L. L. Thurstone, "Mental Tests for College Entrance," *Journal of Educational Psychology*, Vol. X (1919), pp. 129 ff.

that score are sure to be unsatisfactory. In the case illustrated it would be 48. The critical score, whether it be in business, industry or education, may be shifted according to the needs of the institution. Thus, when applicants are plentiful, the "dead line" may be raised and quality improved; when applicants are few the "dead line" may be lowered somewhat to meet emergencies.

In the field of business and industry, intelligence "dead lines" have been established mainly in the simpler occupa-

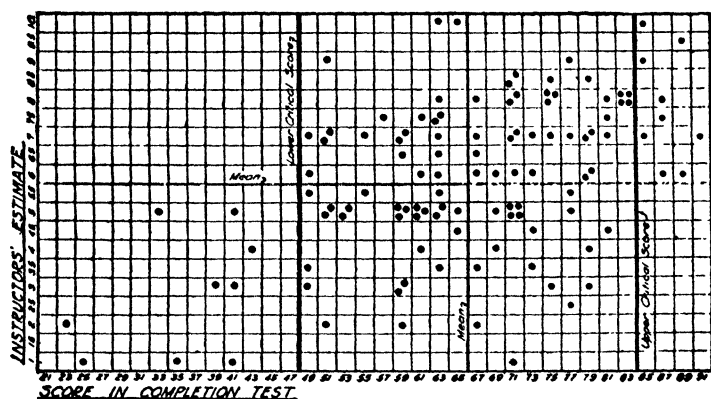


FIG. 22. RELATION BETWEEN TEST SCORE AND SCHOOL WORK

tions and especially in those cases where there is a possibility of using mental defectives. Burr⁶ has prepared an interesting set of minimum demands upon intelligence of certain occupations through the careful study of 375 girl workers of the average chronological age of sixteen years. She emphasizes the tentative nature of her findings. The criterion of success in the occupation was in most instances "three months of uninterrupted employment at the same work." The following is a brief summary of her results,

⁶ E. Burr, "Minimum Intelligence Levels of Accomplishment in Industry," *Journal of Personal Research*, Vol. III (1924), pp. 207 f.

in which the intelligence is expressed in terms of mental age determined by means of the Stanford-Binet Test:

Minimum Mental

Age

- 7 to 8 years—Packing small articles not easily damaged by handling, such as powder-puffs.
- 8 to 9 years—Certain operations in pencil making.
- 9 to 10 years—Crude hand-sewing such as putting buttons on cards, sewing bows on novelties; cutting and pasting in paper-box making; sewing hat linings and steaming materials used in millinery; packing and folding hair-nets.
- 10 to 11 years—Stock-keeping, labelling and checking; winding cotton and wool braid, hand-sewing on garments.
- 11 to 12 years—Covering buckram foundations, sewing in the wire edge and facings of women's hats.
- 12 to 13 years—Sewing on labels at high speed; machine operating for straw and other millinery, for window shades, garters, powder-puffs, etc.
- 13 to 14 years—Assembling of parts requiring some judgment; machine operating in sewing straight seams, bindings, etc., where threading and adjusting machines are necessary; completion of an entire garment.

A study of the intelligence of business men will illustrate the use of the minimum requirements at the higher levels of accomplishment. Bingham and Davis⁶ measured the intelligence and business standing of 102 successful business men. Use of the correlation method showed a zero relationship between these two measures. This result is startling indeed until it is recognized that all the men were in the upper half of the population as far as intelligence is concerned. Business competition itself had set the "dead line"

⁶W. V. Bingham and W. T. Davis, "Intelligence Test Scores and Business Success," *Journal of Applied Psychology*, Vol. VIII (1924), pp. 1 ff.

for success at the level of average intelligence. No one with intelligence lower than the average could hope to attain the degree of business success represented by this group. Given this minimum intelligence requisite for business success, the relative degree of success depends upon other factors than intelligence. Of such factors there may indeed be a great number. This absence of a high positive correlation between intelligence and success, when a minimum level has already been established, is characteristic of a number of experimental findings, and demonstrates both the strength and weakness of the intelligence test for vocational purposes.

TABLE XXVII. RELATION BETWEEN INTELLIGENCE AND SECRETARIAL PROFICIENCY—INTELLIGENCE SCORE

School Standing	50-	70-	90-	110-	130-	150-	170-	190-
Excellent	..	..	..	..	4	13	7	1
Very Good	..	..	1	1	8	5	2	..
Fair	..	..	1	7	3	3	..	..
Unsatisfactory	..	1	2	1	2	..	..	..

The situation would be rare indeed in which any practical minimum intelligence score would eliminate *all* unsuccessful employees. The failure of the device is naturally the greatest where other than intellectual traits play a leading part. The figures in Table XXVII¹ show a case of this sort. Sixty-one students in training for secretarial work were given an intelligence examination (Army Alpha) and were also graded by their instructors for success in their work. The cases are distributed according to their intelligence score and according to their school standing. It will be observed that some of the poor students have a high intelligence rating and that some of the good students have a relatively low

¹ A. T. Poffenberger, "The Selection of a Successful Secretary," *Journal of Applied Psychology*, Vol. VI (1922), pp. 156 ff.

grade of intelligence. Of course, it must be understood that selection of a fairly rigid sort had already taken place by way of the entrance requirements of the school. If this were not the case, a minimum score could be set that would be much lower than appears on this chart. But no minimum score will eliminate the unsatisfactory students who now enter the school, and not at the same time eliminate those who are satisfactory.

THE MEASUREMENT OF MAXIMUM INTELLIGENCE REQUIREMENTS

Evidence is accumulating to show that maximum as well as minimum intelligence levels should be established for many or all occupations, in order that work shall bring to each individual the greatest amount of success and satisfaction. The person who is vocationally unsuccessful may be one who "is attempting to succeed in an occupation demanding greater intelligence than is his"; or one who "is in an occupation which fails to make sufficient demands upon his intellectual capacity to keep him interested and at work." There are many so-called monotonous positions that intelligent persons find irksome and unsatisfying. Consequently, it seems that in such cases a high degree of intelligence is not only not required but is a positive handicap to endurance of the steady routine work. Persons of low mentality may succeed in just such work.

The experiment reported by Scott and Hayes^{*} will repay repetition on a more extensive scale and with more satisfactory measures of intelligence. They obtained for a number of occupations, both an indication of the intelligence of the workers and their satisfaction in their work. Intelligence was inferred from the grade reached in school, and satis-

^{*}W. D. Scott and M. H. S. Hayes, *Science and Common Sense in Working with Men* (Ronald Press Co., New York, 1921), pp. 73 ff.

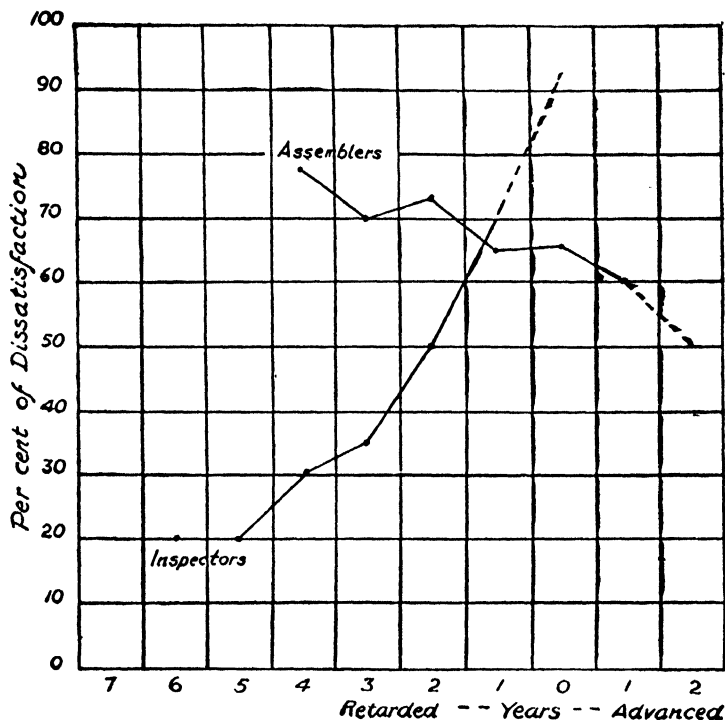


FIG. 23. RELATION BETWEEN INTELLIGENCE AND SATISFACTION

faction was gauged from the introspective report of the worker. The relation between these two measures in the case of two of the occupational groups is shown in Figure 23. The vertical scale is in terms of the per cent of persons dissatisfied with their job, and desiring change. The scale ranges from zero, or no cases of dissatisfaction, to 100, or dissatisfaction of all the workers. The horizontal scale indicates the number of years retarded or advanced in school, with the zero point representing the normal school status. It should be noted that in the case of the inspectors the greater the mental capacity the greater the dissatisfaction. The work in this department is reported as simple, "fool-

proof," repetitive and monotonous. Only those of relatively low intelligence could find satisfaction in this work. It is interesting that in the inspection department were found both the highest percentage of satisfaction and the highest percentage of dissatisfaction. This means that in this department there is opportunity, through the right adjustment of mental ability to the job, to secure the highest degree of stability, and there is also danger, through maladjustments, of producing the greatest instability. "From the point of view of job satisfaction, this single occupation is both the best and the worst in the plant—depending on the extent to which selection and assignment of workers are based on a consideration of the mental alertness of the applicant."

The curve for the assemblers takes just the opposite course. The most dissatisfied are the least intelligent and the most satisfied are the most intelligent. The assembling operation required a high degree of manipulative skill and a fair degree of judgment. The greatest degree of retardation found in this occupation was four years, compared with six years in the other. This probably means that mentalities as low as six years of retardation were not only dissatisfied but could not even survive in this occupation.

The most notable collection of data on the establishment of intelligence limits for various occupations is found in the intelligence and personnel records obtained by the United States Army during the war. These have been amplified and corrected somewhat by Fryer⁹ and appear in his table of occupational intelligence standards which is reproduced in Table XXVIII. The maximum and minimum scores represent the limits within which success in the occupation can be expected. These limits do not include, however, the whole range of intelligence that is found within the occupation.

⁹ D. Fryer, "Occupational Intelligence Standards," *School and Society*, Vol. XVI (1922), pp. 273 ff.

TABLE XXVIII. INTELLIGENCE LIMITS FOR VARIOUS OCCUPATIONS

Intel. Group	Score Ave.	Score Range	Occupation
A	161	110-183	Engineer (Civil and Mechanical)
	152	124-185	Clergyman
	137	103-155	Accountant
B	127	107-164	Physician
	122	97-148	Teacher (Public Schools)
	119	94-139	Chemist
	114	84-139	Draftsman
	111	99-163	Y.M.C.A. Secretary
	110	80-128	Dentist
	109	81-137	Executive (Minor)
C +	103	73-124	Stenographer and Typist
	101	77-127	Bookkeeper
	99	78-126	Nurse
	96	74-121	Clerk (Office)
	91	69-115	Clerk (Railroad)
	86	59-107	Photographer
	85	57-110	Telegrapher and Radio Operator
	83	64-106	Conductor (Railroad)
	82	57-108	Musician (Band)
	81	59-106	Artist (Sign Letterer)
	81	60-106	Clerk (Postal)
	81	57-109	Electrician
	80	62-114	Foreman (Construction)
	80	56-105	Clerk (Stock)
	78	54-102	Clerk (Receiving and Shipping)
	78	61-106	Druggist
	77	59-107	Foreman (Factory)
	75	56-105	Graphotype Operator
C	74	53-91	Engineer (Locomotive)
	72	54-99	Farrier
	70	46-95	Telephone Operator
	70	44-94	Stock Checker
	69	49-93	Carpenter (Ship)
	69	48-94	Handyman (General Mechanic)
	69	46-90	Policeman and Detective
	68	51-97	Auto Assembler
	68	47-89	Engineman (Marine)
	68	42-86	Riveter (Hand)
	67	50-92	Toolmaker
	66	45-92	Auto Engine Mechanic

TABLE XXVIII. INTELLIGENCE LIMITS FOR VARIOUS OCCUPATIONS—*Continued*

Intel. Group	Score Ave.	Score Range	Occupation
C <i>cont.</i>	66	45-91	Laundryman
	66	49-86	Gunsmith
	66	44-88	Plumber
	66	44-88	Pipefitter
	65	44-91	Lathe Hand (Production)
	65	43-91	Auto Mechanic (General)
	65	43-91	Chauffeur
	65	42-89	Tailor
	65	44-88	Carpenter (Bridge)
	64	43-88	Lineman
	63	40-89	Machinist (General)
	63	46-88	Motor Cyclist
	63	41-86	Brakeman (Railroad)
	62	31-94	Actor (Vaudeville)
	61	40-85	Butcher
	61	44-84	Fireman (Locomotive)
	61	39-82	Blacksmith (General)
	60	38-94	Shop Mechanic (Railroad)
	60	36-93	Printer
	60	40-84	Carpenter (General)
	59	40-87	Baker
	59	39-83	Mine Drill Runner
	59	38-81	Painter
	58	37-85	Concrete Worker
	58	40-83	Farmer
	58	37-83	Auto Truck Chauffeur
	58	37-82	Bricklayer
	57	41-81	Caterer
	57	39-71	Horse Trainer
	56	38-76	Cobbler
	55	35-81	Engineman (Stationary)
	55	34-78	Barber
	55	35-77	Horse Hostler
	52	38-96	Salesclerk
	52	33-74	Horse Shoer
	51	31-79	Storekeeper (Factory)
	51	26-77	Aeroplane Worker
	51	31-74	Boilermaker
	50	33-75	Rigger
	50	30-72	Teamster
	49	40-71	Miner (General)
	48	21-89	Station Agent (General)

TABLE XXVIII. INTELLIGENCE LIMITS FOR VARIOUS OCCUPATIONS—*Continued*

Intel. Group	Score Ave.	Score Range	Occupation
C —	40	19-67	Hospital Attendant
	40	19-60	Mason
	35	18-62	Lumberman
	35	19-57	Shoemaker
	32	16-59	Sailor
	31	20-62	Structural Steel Worker
	31	19-60	Canvas Worker
	30	16-41	Leather Worker
	27	19-63	Fireman (Stationary)
	27	17-57	Cook
	26	18-60	Textile Worker
	22	16-46	Sheet Metal Worker
	21	13-47	Laborer (Construction)
D	20	15-51	Fisherman

Approximately the poorest and the best quarter have been eliminated, on the assumption that neither group could successfully adjust itself to the occupation. A casual examination of the table shows how exceedingly rough any guidance of an individual must be if based solely or even mainly on intelligence status. Grade C, for example, which represents the average intelligence of the population, covers fifty-four occupations in the table; and the table is in no sense a complete catalogue of occupations. Some determinant other than intelligence would be required to discover which of the fifty-four occupations a C person should engage in. The same is true of the other five intelligence grades.

A fourfold classification is as much as can be hoped for at present, such as professional, skilled, semi-skilled, and unskilled (labor). The overlapping of the grades is considerable; for instance, receiving and shipping clerk, which is the lowest occupation in the C plus grade, ranges from

54 to 102, while dentist in grade B ranges from 80 to 128. Whether an applicant for guidance should be a clerk or a dentist could not be decided from these records alone. A very suggestive classification might be built upon the nature of the materials and the processes with which the worker has to deal. An analysis of the Occupation-Intelligence chart shows that an intelligence of 86 works well with raw materials and domesticated animals. The intelligence of 100 can handle materials in a semi-finished state and can use simple tools, but cannot deal effectively with symbols. Working with abstract symbols of a simple sort requires an average intelligence of 115. Individuals in the 120 class can handle complex symbols and can deal with the simpler relations with other human beings. But those dealing chiefly with other individuals in the relation of foreman, executive, officer and in the professions require the exceptional intelligence indicated by an average score of 130.

When occupational standards have become more refined and free from error, it may be possible to predict fitness more specifically than is safe under the present circumstances. We may then say to one who wants to become an electrician, and who has an intelligence score of 57, that he could do the work but would always stand among the poorest of this group; to another with a score of about 80 that he could not expect to be more than an average electrician; to still another with a score of about 110 that he has the ability to stand near the top of his occupational group; to another with a score of 130 we should be forced to say that he is capable of better work and would not be happy in such an occupation. Such a set of predictions is very similar to that which is already in use in one college where intelligence examination is part of the routine of entrance. In that institution the specifications are as follows, in terms of the Thorndike Intelligence examination for High School Graduates:

A student with a score of :

- 50 or less—Should not be admitted.
- 50 to 60—Should be admitted only if of extraordinary zeal or has suffered very great educational handicaps.
- 60 to 70—May be admitted if sufficiently in earnest and otherwise desirable.
- 70 to 85—Intellect sufficient to obtain a college degree.
- 85 to 95—Intellect enough to do collegiate and professional work with distinction.
- 95 or more—Worth admitting in entire disregard of technical deficiencies.

It might be presumed that there are some occupations where intelligence is such a vital factor that the correlation between performance and intelligence will be high enough for accurate prediction of success on the basis of intelligence score alone, and where one can say that the greater the intelligence the greater the success will be. Some indication of the possibilities at least may be gained from the relationship between intelligence test record and performance in college work. There, if anywhere, intelligence should play a major rôle. And yet the best correlation that has been obtained in this case is $+.60$.¹⁰ It is, therefore, hardly likely that any branch of vocational work will show a higher correlation than this. It is the impression of those who have worked with the present measuring instruments that the correlation is limited not so much because of the inadequacy of the test but rather because other factors play a significant part in determining success. To predict the degree of success of *any given individual* on the basis of a coefficient of

¹⁰ It should be remembered that in every college the intelligence deadline has already been set rather high through entrance requirements, and that this correlation is obtained only from those who enter. It has been predicted that if there were no restrictions upon entrance, the correlation between intelligence score and achievement would be as high as $+.80$.

correlation requires that the correlation be higher than any that have been obtained thus far.

INTELLIGENCE AS AN INDICATOR OF CHARACTER

The importance which everywhere attaches to such non-intellectual traits as are usually included in the term "character" has led to the search for such a positive relationship between that and intelligence as will make the presence of the latter an indicator of the presence of the former. In the "long run" it must be true that desirable traits of character and intelligence go together. Thorndike¹¹ puts the matter very clearly in the following paragraph:

The abler persons in the long run are the more clean, decent, just and kind. To this feature of human nature which has tied good-will toward men to ability, a large proportion of the blessings which the common man enjoys to-day are due. The brains and ability of the world have been, and still are, working for the profit of others. If Pasteur had been of mean and brutal nature, he could have kept his first discoveries as a trade secret, extorted a fortune in fees, and lived in sensuous idleness, leaving the world without his still more important later work. Flexner or Carrell could poison their enemies or rivals except for the tradition of justice and generosity which the positive correlation between intelligence and morality has made a part of scientific work, and which their own natures gladly maintain.

Although such a relationship gives one confidence in human nature, it is far from furnishing the basis for prediction of individual character from individual intelligence. The few researches that have been reported in this field suggest that a correlation of $+ .40$ is about what is to be expected. This allows for the numerous exceptions that will come to the mind of the reader—those cases where men of high intelligence have demonstrated their cruelty, dishonesty, selfishness and immorality.

¹¹ E. L. Thorndike, "Intelligence and its Uses," *Harpers Monthly Magazine*, Vol. CXL (1920), p. 227.

SPECIAL CAPACITIES

There are two opposing views current in psychological theory concerning capacity. One is that there are no specialized capacities, that two individuals of the same intelligence level, and independent of training, can do equally well anything to which they may "turn their hands." The other view is that in addition to a certain degree of intelligence each person is endowed with special capacities of one sort or another, or better still, that intelligence is nothing more than a kind of average of all the special capacities. The former would certainly be the simpler point of view from which to construct a vocational psychology, since a good measure of general capacity would be all that the practitioner would require. Both views would get some support from a casual survey of the tests which are at present used for measuring all sorts of specialized vocational activities, for they bear a striking resemblance to the components of the general intelligence examination, both in their form and in their content.

Careful study of the problem almost forces the opinion that there are special capacities. It is to be expected, of course, that in the long run a person of high intelligence will do everything better than one of low intelligence, but the individual of high intelligence will do some things better than others; and of two persons of equal intellectual capacity one may do certain specialized activities better than the other. The theoretical discussion of general and special capacity has had relatively little influence upon practical measurement methods, for in vocational psychology one is faced with a particular problem, let us say, to select competent persons for training in clerical work, or to select a clerical worker for a particular job. He proceeds to try out various tests, some general and some specific in character, and selects by empirical methods those that are diagnostic. It makes no

particular difference whether the right test happens to be an intelligence test or a special capacity test.

THE SAMPLING METHOD

A variety of methods¹² has been employed for the construction of tests to solve particular vocational problems. Four different principles are discoverable in these methods, although rarely, if ever, is a test built upon only one of the principles. The principle that receives the emphasis is the one that gives color to the test. The simplest of these methods is the sampling method, which consists, as the name implies, in choosing one or more specimens of the actual work required in the occupation and measuring the ability of the candidate to do them. The success of the method depends primarily upon the feasibility of obtaining a sample which shall be representative of the total occupation and which may at the same time be given under test conditions. In some kinds of work such as typing, filing cards, checking, etc., sampling is readily accomplished, while in occupations of the professional sort and those involving executive duties sampling may be impossible. A very serious objection to the sampling method as a measure of special capacities is that it gives a decided advantage to *acquired* as contrasted with *native* capacity. In fact, it seldom furnishes a measure of the latter, although that is the function that most of the special tests are intended to perform. A sample test in the taking of stenographic dictation would be impossible for an untrained individual, who had the capacity to far exceed her more fortunate trained competitors after a short period of training.

¹² For an interesting critical discussion of such methods, see F. Watts, "The Construction of Tests for the Discovery of Vocational Fitness," *Journal of Applied Psychology*, Vol. V (1921), pp. 240 f. For a complete survey of vocational methods together with a bibliography of 233 titles see W. V. Bingham and M. Freyd, *Procedures in Employment Psychology* (A. W. Shaw Co., Chicago, 1926).

The sample test is most serviceable in the development of the so-called Trade Tests, which are intended to be measures of learned reactions. The following test for a butcher,¹³ which is an oral information test, shows clearly the dependence of success upon training, rather than upon natural capacity. Still, of two individuals who had equivalent contact with such information, the more intelligent one would make the better score. No matter how carefully the work has been sampled, it is necessary to check the test for its predictive power against actual accomplishment by a method such as described in the next paragraph.

BUTCHER

1. From what part are pork chops usually cut?
2. How many ribs are cut to a rib of beef?
3. What are two knives which a butcher uses?
4. From what part of the hog do you get picnic or California hams?
5. What is located between the first rib and the hip?
6. What is the average weight of sweetbreads?
7. From what is tripe made?
8. From what part of a hog is salt pork made?
9. How many ribs are left on a chuck of beef?
10. What is the average weight of a plate from a 500 pound dressed steer?
11. About what should a hind quarter of a 500 pound dressed steer weigh?
12. What should a ham weigh from a 150 pound hog, trimmed to pickle?
13. What do you call the strip of fat along the back from which the loin has been pulled?
14. What is the average weight of a steer liver?
15. What is the part of a beef between the front legs?
16. How old should a calf be before it is butchered?
17. What do you call a calf under 7 days old?
18. Where is the cross rib located?

¹³ J. C. Chapman, *Trade Tests* (Henry Holt and Co., New York, 1921), p. 145.

THE EMPIRICAL METHOD

The second method is known as the empirical or correlation method. It has been developed and used especially by American psychologists. When used in its pure form it does not resort to sampling from the job, but finds out by "trial and error," that is, by testing out a great variety of functions, which ones are essential for success in the occupation. Since the measures are not selected on the basis of superficial resemblance to the work in question, their value must be determined by checking performance in the test against performance in the occupation. There must be available, therefore, a group of people who have undergone a certain amount of training and who have reached various degrees of proficiency ranging from very high to very low proficiency. In the cases where there turns out to be a close relation between proficiency in the test and in the occupation, the test is considered a good one. Others which do not show a sufficiently close relation are discarded. Tests so derived are believed to be measures of native capacity in spite of the fact that they are checked against persons with training.¹⁴ The assumption is, however, that, since the functions tested do not duplicate the actual work, they will have been changed little or not at all by the special training. A more valid application of the empirical method would require that a group of persons be tested before training and then followed through their careers to discover what relative degree of proficiency each attains, and the relation of this degree of proficiency to performance in the original test. The difficulties in such a procedure are obvious, as the stand-

¹⁴ The statistical technique involved in the application of the correlation method is clearly presented in H. E. Garrett, *Statistics in Psychology and Education* (Longmans Green and Co., New York, 1926).

ardization process would in some cases require years to complete. Yet the technique is by no means impossible and the results would justify the cost in time and money.¹⁵

There are two minor objections to this method. It is extremely laborious, since it is to be expected that many of the tests which are tried out will be found useless. In developing a test for clerical ability, for instance, over one hundred separate tests were tried before a satisfactory set was obtained. Another objection is that the best tests may still remain undiscovered, as the search for them is of the "trial and error" sort. It is rare, however, that some guiding principle, some notion of what the test should be like, is not at work in the making of the preliminary survey. Such a survey, if competent, will effect a great saving of labor and increase the chances of getting the best set of tests possible for the purpose. When the search for test material is thus restricted, it is done either by sampling the work which would give it the character of a trade test, or by an analysis of the occupation, which would involve the principle next to be described. The content of a test for clerical ability is given below. There are 10 parts in the test, and the names indicate merely the character of the various parts. A certain resemblance to actual clerical work will be evident, as in parts 1, 2 and 3. In this type of test the various parts are weighted according to their relative importance, which is determined empirically. The candidate is given a total score for the series of ten parts. A very useful modification of this method consists in substituting the "critical score" or "dead line" method for the correlation method. The advantages accruing from this change are such as were described on page 302.

¹⁵ For an account of the use of such procedure on a small scale for the measurement of natural capacity for typing, see H. W. Rogers, "Tests for Stenographers and Typists," *Journal of Applied Psychology*, Vol. I (1917), pp. 268 f.

CLERICAL TEST

- No. items
in test
- Part 1**—Finding errors in addition and subtraction, as: 60
- $15 - 4 = 12$
 $5 + 9 = 13$
 $14 - 5 = 9$
- Part 2**—Translating prices into letters by means of a code, as: 60
- | Code—w o r k i n g | d a y | Price | Code |
|--------------------|-------|---------|-------|
| 1 2 3 4 5 6 7 | 8 9 0 | \$ 1.46 | _____ |
| | | \$14.27 | _____ |
- Part 3**—Copying numbers containing 5 to 9 digits, as: 50
- 8275463
 20437118
 604213
- Part 4**—Identifying fruits from a table of attributes 16
- Part 5**—Completing sentences, as: 30
- Scorch means to ——— (cut, burn, bruise, turn)
 Fatigue means to be ——— (jubilant, weary,
 boisterous, original)
- Part 6**—Recognizing meanings of words, as: 105
- | | |
|--------------------------------|----------|
| Mark words about Church with C | fight |
| “ “ “ War with W | brother |
| “ “ “ Business with B | bishop |
| “ “ “ Relatives with R | abbott |
| | purchase |
- Part 7**—Reading sentences whose words are spelled backward, as: 20
- woH ynam sgel sah a esroh?
 tahW eno drow snaem tsuj eht emas sa “emoc kcab”?
- Part 8**—Checking statements as true or false, as: 30
- The smallest piece of minted money in U. S. is mill.
 Private secretaries are often promoted to be stenog-
 raphers.
 A check made out to a person directly can be cashed
 by him without endorsement.

CLERICAL TEST—*Continued*

	No. items
Part 9—Checking a table of numbers for pairs that add to 10, as :	50
Sample: 5 0 5 3 1 9 8 2 0 9 6 4 2 1 0 1 9 8 1 3 0 8 5 9 6 5 7 6 9 4 0 1 3 2	
Part 10—Translating pairs of letters into numbers by reading from a table of numbers	40
Total number of items in test.....	461

THE ANALYTIC METHOD

The analytic method contrasts sharply with the empirical method, because it consists essentially in the analysis of an activity into the elementary functions which comprise it, and the preparation of devices for testing or measuring these separate elementary functions. Few activities have been analyzed in this fashion. The best known case, the analysis of musical ability, shows what a difficult and laborious process it is when thoroughly done. Seashore has devised measures for some thirty separate processes involved in musical ability. The test record of an individual is presented in the form of a psychograph or picture showing performance in each test separately instead of giving merely a total score. To combine separate scores is not at present feasible, since the relative value of each separate function in determining proficiency has not been computed. In fact it may never be desirable to do so, for one of the advantages of the method is that it portrays in detail the musical makeup of the person, the particular respects in which he is deficient and those in which he is proficient. Figure 24 contains two such psychographs.¹⁶ The solid line is the record of "a young lady who is markedly deficient in musical capacity

* Adapted from C. E. Seashore, "Vocational Guidance in Music," University of Iowa Monographs (1916, First Series), No. 2.

throughout, and has not profited by her extensive musical education"; the dotted line is that of a person of "unusually high natural talent for music, though relatively uncultivated." The names of the different tests are given on the left. A per cent scale extends horizontally, and each record shows in what per cent of the population the person stands

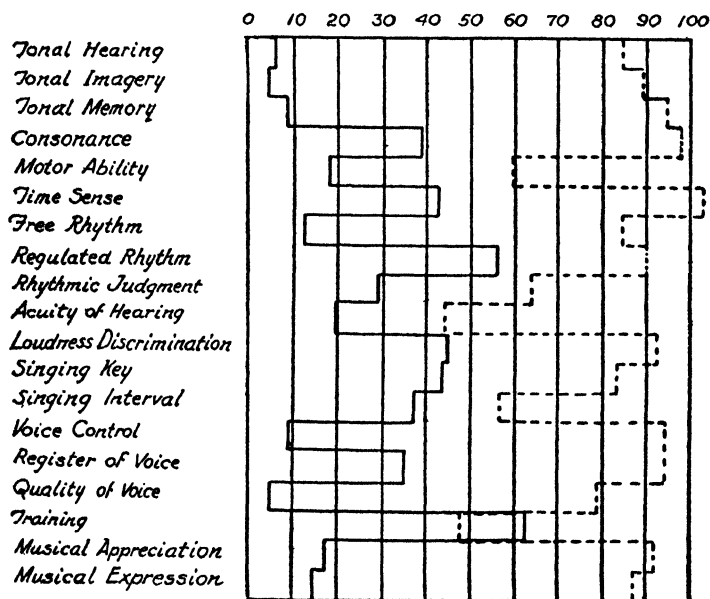


FIG. 24. PSYCHOGRAPHS OF MUSICAL ABILITY

in the trait. Thus, in tonal hearing one of these persons stands in the lowest tenth of the population and the other among the best fifth of the population. The score for each trait is to be interpreted in a similar fashion.

No matter how carefully the analysis has been made, the predictive value of the test must be proven. For this purpose the correlation method (empirical method) may be used, or a rougher check may be adopted such as studying the



FIG. 25. VITELES MOTORMAN SELECTION TEST (NEW MODEL, 1925)

test performance of persons representing the extremes of musical ability, like the two cases shown in Figure 24. The analytic method should yield tests of natural rather than acquired capacity. Although some of the functions measured in the musical psychograph show their resemblance to musical work, they are measured in such a fashion as to minimize the effects of training. It has been well demonstrated that pitch discrimination, loudness discrimination, etc., are only slightly modified by training.

THE ANALOGY METHOD

The analogy method requires the construction of a test situation which is analogous to but not identical with the actual occupation, nor merely a sample of it. It implies an analysis of the work into its elements, just as in the analytic method, but instead of testing for these elements directly and obtaining a total score or psychograph in that fashion, the elements are reconstructed into a pattern to which the candidate reacts as a whole. The test is therefore assumed to call out "as a combination the essential capacities and interests concerned, in much the same proportions as they are demanded in the actual tasks, but in such a manner as to allow potential capacity, when necessary, to compete on equal terms with capacity already fully developed." Aside from the great difficulty of making the analysis and reconstructing the elements, there is danger that a test so devised will resemble so closely the actual work that it will become a sample test, and give too much weight to training. One can never rely entirely upon the accuracy of analysis and reconstruction, so that some kind of checking up is essential, such as the correlation method implies. The Viteles Motorman Selection Test¹⁷ is a good

¹⁷ M. S. Viteles, "Research in the Selection of Motormen," *The Journal of Personal Research*, Vol. IV (1925), pp. 100 f. and 173 f. See also *Electric Railway Journal*, Vol. LXVII (June 5, 1926).

specimen of the analogy type of test. Although the technique by which this test has been constructed is too involved for description here, Figure 25 shows its general character. The candidate is required to operate levers by hand and foot in response to a system of signals that are thrown on the screen. The author considers it an important feature of the test that "the applicant employs, in reacting, approximately the same set of muscles that are used in actual street-car operation without duplicating the responses used in operating the car."

This brief survey of tests¹⁸ for special capacities shows that no one of the four principles underlying their construction is entirely adequate when used alone, and that the ideal test will probably be evolved from a combination of all the methods. The nature of the test can be determined best by an analysis of the occupation such as is implied in the use of the analytic and the analogy methods. The actual contact with the worker and the job which these methods necessitate is recognized to be a healthful corrective for the strictly laboratory attitude toward test construction. To test a candidate with an operation somewhat like the work that he hopes to do will be more likely to arouse his interest and coöperation than the more abstract forms of test. Finally, the empirical or correlation method is essential in the final proving of the predictive value of the test. Circumstances under which the tests have to be devised often require emphasis on one method and the slighting of another, but all should play their part. Up to the present at least, conditions have been such that the empirical method has had to be relied on to the partial eclipse of the other methods.

¹⁸ It is impossible to give even a partial list of tests of special capacity that are now in use. The reader is referred to the following for a survey of this material: A. W. Kornhauser, "The Psychology of Vocational Selection," *Psychological Bulletin*, Vol. XIX (1922), pp. 192 ff. (Annotated bibliography.)

CHAPTER XVII

THE MEASUREMENT OF CHARACTER AND INTEREST

SUBTRACT from the conditions of success in any line of work the factors of intelligence, special capacities and education, and an appreciable residue remains to be accounted for. It is being gradually resolved into such items as physical health, personality, character, temperament, interest and social sense. In one or more, or all, of these reside the stamina and the driving power that enable one to make the most of his intellectual endowment, and that guide his activities toward what is useful and commendable rather than toward what is harmful and reprehensible. Attempts at objective measurement¹ have been directed at character and interest particularly. The need for such measurement has become urgent because tests of intelligence and special capacity, when used alone, have recognizable limits in the diagnosis of vocational fitness.

DEFINITION OF CHARACTER

Definitions of character have been derived in much the same way as the definitions of intelligence, and the conflict of opinion in the one case resembles that in the other. According to one view character is a kind of entity, which can be measured by way of its behavior manifestations. The cen-

¹ A discussion of objective methods of measuring character, together with an annotated bibliography, will be found in M. A. May and H. Hartshorne, "Objective Methods of Measuring Character," *Pedagogical Seminary*, Vol. XXXII (1925), pp. 45 f.

tral idea in the tests developed by Downey,² for instance, is that people vary in the amount of nervous energy which they can store up, and in the ease or difficulty with which this energy may be released into motor mechanisms of the body and thereby transformed into action. These are native qualities called by Downey "will temperament." She makes a distinction between these and character, the latter being a product built upon these native qualities interacting with intellect, social pressure and habit mechanisms. To use her own words, "will temperament determines the form assumed by character, although it does not determine its content." Students of personality measurement are inclined to use the two terms, will temperament and character, synonymously.

A more prevalent conception of character is that it is merely an expression for the sum total of, or a cross section of, ways of behaving. Either conception would lend itself to the construction of a general character test, although the former point of view would appear to make the task a simpler one. It would be necessary merely to discover measures of energy supply and of modes of its discharge, as in the Downey test. According to the other conception, it would be necessary to sample all the varieties of behavior. As a matter of fact, the only attempt to create a general character test to date is that of Downey. The more usual approach to the problem is not even to attempt a complete catalogue of character reactions, but to study those specific ones that demand measurement for practical purposes. Thus attempts are being made to measure honesty, aggressiveness, social sense, control of impulses, mental balance, self-assertiveness, self-confidence, credulity, etc., at the call of busi-

² See J. Downey, *The Will Temperament and its Testing* (1922), World Book Co., Yonkers, New York; also, E. Webb, "Character and Intelligence; An Attempt at an Exact Study of Character," *British Journal of Psychology*, Mon. Supplement, Vol. I (1915), No. 3.

ness, industry and education. When a sufficient number of these special tests have accumulated, it will be a simple matter to combine them into a character test, giving to each the weight that its relative importance deserves. In just such a way have our group intelligence examinations evolved.

TESTS OF GENERAL AND SPECIFIC CHARACTER TRAITS

According to the first conception of character, individuals range from one extreme, where there is an abundance of energy which flows freely, to the other extreme where there is little energy subject to great inhibitions. The Downey tests, which are intended to measure the amount and freedom of this energy, consist of twelve parts, all but two of which measure actions expressed in handwriting. The three types of character which the tests disclose most clearly are the "mobile" type showing speed and fluidity of action, the "deliberate" type showing carefulness and persistence of reaction, and the "aggressive" type showing forcefulness and decisiveness of reaction. Figure 26³ reproduces two of these types, presented in the form of profiles or psychographs. The names of the tests are given at the bottom of the chart and the degrees of the trait are marked on the scale of ten steps at the left. Profile A represents the "mobile" type and pictures "a young woman, a teacher of physical education, vigorous, alert, athletic, and highly impulsive, but not strongly aggressive." Profile B represents the "deliberate" type, and pictures "a research scientist. The excessive slowness in decision, the low degree of impulsions, and the great care for detail are highly descriptive of the man in question."⁴

³ Adapted from J. Downey, *The Will Temperament and its Testing* (World Book Co., Yonkers, New York, 1922), pp. 77 and 79.

⁴ For a critical analysis of the Downey will temperament tests, see M. A. May, "The Present Status of the Will Temperament Tests," *Journal of Applied Psychology*, Vol. IX (1925), pp. 29 f.

A good illustration of the specific character test is the attempt of Moore and Gilliland⁵ to measure aggressiveness. These authors, very early in their work, made a discovery that is most significant for the measurement of character. They found that in order to measure aggressiveness a bat-

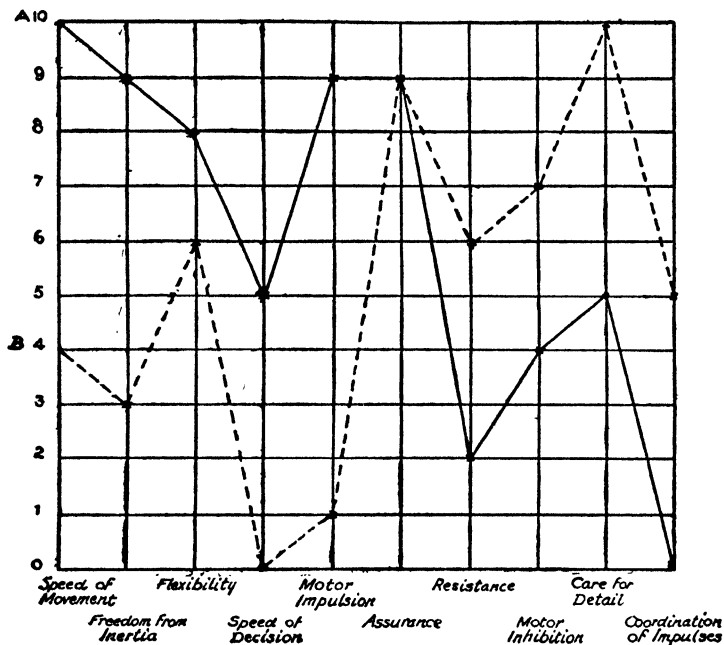


FIG. 26. PSYCHOGRAPHS OF THE MOBILE AND DELIBERATE TYPES

tery of tests yielding an aggressiveness profile similar to the Downey general profile would be necessary, rather than a single test. Thus it appears that our names for character traits stand for very complex functions and not single irreducible units of character. One of the proposed battery

⁵H. T. Moore and A. R. Gilliland, "The Measurement of Aggressiveness," *Journal of Applied Psychology*, Vol. V (1921), pp. 97 ff.

of tests is the eye-control test, which measures the degree to which one can fix his eye upon the experimenter while performing simple problems in mental arithmetic. The most aggressive person will be that one who has the greatest eye-control or who, to the greatest degree, lacks the "shifty eye" so frequently associated with personal weakness. The test was tentatively standardized against twenty-six people, thirteen of whom were known to be highly aggressive and thirteen notably lacking in this trait. The number of eye-movements detected in the former group was 6 and in the latter group was 72, which amounts to an average of about .5 eye-movements per aggressive person and 5.5 eye-movements per non-aggressive person. Whether such a test will have sufficient predictive value to form a component of the future character test is still to be determined. Many of the character tests described in psychological literature have evolved, like this one, from a popular conception of the meaning of behavior signs. In that way they resemble somewhat the sample tests of special capacity and, like these, may be found to measure acquired rather than native traits.

In addition to tests devised in the objective fashion described above, attempts have been made to measure the capacity to discriminate between what is "good" and what is "bad," between what is "right" and what is "wrong." * Tasks like the following are given in which the proper answer is to be indicated by a check mark:

If a playmate hits you without meaning to do it, you should
hit him back
make him say he is sorry
excuse him

* One of the best standardized tests of this sort is described in S. C. Kohs, "An Ethical Discrimination Test," *Journal of Delinquency*, Vol. VII (1922), pp. 1 ff.

Draw a line under the worst
bullying, stealing, blackmail, cheating, swindling
Bad means
clean, wrong, bath, good

Although distortion of moral or ethical judgments as shown by tests of this type may be indicative of an equally distorted character, normal reactions to such a test do not in the same way indicate a normal or "good" character. There is a distinction between knowing what is "right" and doing it. Morality, as Terman points out, depends upon two things: (a) the ability to foresee and to weigh the possible consequences for self and others of different kinds of behavior; and, (b) the willingness and capacity to exercise restraint. Although (b) presupposes (a), the reverse is certainly not the case. Discrimination tests furnish an interesting and valuable type of information about an individual, but they do not measure character as it is commonly understood.

The recent studies of glandular activities in the human body have opened the possibility⁷ of measuring character traits either by measuring the glandular functions directly or by way of the reflection of their activity in bodily development. The literature⁷ containing data from both abnormal and normal personalities leaves little doubt that there is a positive relationship between behavior and some of these obscure physiological reactions. Whatever scientific value the discovery of such relationships may have, it seems very unlikely that they will take on practical significance for the vocational psychologist. The correlations, though positive, are too slight to make reliable predictions of behavior from them. There is, moreover, little reason to believe that refinements of method will increase the size of these correlations.

⁷ An optimistic account of such relationships is presented in L. Berman, *The Glands Regulating Personality* (The Macmillan Co., New York, 1921).

THE STABILITY OF CHARACTER TRAITS

A very important distinction is frequently made between character and intelligence to the effect that, whereas intelligence comes in the nature of an endowment from immediate ancestors, character is fluid and is to be molded through training. It is surprising what slight scientific evidence is at hand concerning the question. What evidence there is from the study of family histories suggests that character and temperament, like intellect, are transmitted from parents to children, but that environmental influences have greater potency in determining the nature of their manifestations than is the case with intelligence. If character and temperamental traits are not relatively fixed in their nature, it would be futile to measure them for vocational purposes. The problem of the stability of character is a complex one and can be dealt with more effectively if broken up into three sub-problems: first, to what extent is any given character trait the product of training; second, to what extent is any specific character reaction determined by the situation in which the individual is placed at the moment; and third, to what extent are our character traits specialized?

INFLUENCE OF TRAINING UPON CHARACTER

One scientifically devised and well-controlled experiment has been performed to discover the degree to which character traits can be developed through the inculcation of higher ideals of action. Voelker^{*} measured the effects of three months of training in the ideals of trustworthiness upon two troops of boy scouts. Before the training period he measured the trustworthiness of the group by means of a series of real, tempting situations. The results of a retest

^{*} P. Voelker, *The Function of Ideals and Attitudes in Social Education* (Teachers College, Columbia University, New York, 1921).

at the end of the training period, after checking against similar measurements upon two control groups receiving no such training, furnished the data upon which the effects of the training were computed. Expressed in terms of amount of improvement, the training is responsible for an increase of about 22 per cent in trustworthiness. The correlation between test and retest was higher in the control group than in the trained group. "This is evidence of the fact that the training took effect in the experimental groups, changing some individuals more than others and thus causing a general shifting in their rank in trustworthiness." The further fact is disclosed that the least improvement occurred in those who made the best record in the first test, and the greatest improvement in those who made the poorest record in the first test. That is, there seemed to be a general "leveling up" in trustworthiness as a result of the training. This is in contrast to the usual finding in regard to intellectual traits where training tends to increase rather than decrease differences. The following paragraph contains an important conclusion from the study which should be verified by further careful research:

It was not to be expected of course that uniform results would be achieved even with uniform treatment. We do not get such results in our teaching of arithmetic or spelling or music. Some individuals who are subjected to training have already approximated their limit of improvement. Moreover, in the field of moral training, as in other fields, individual differences in native capacity will stare us in the face. It is, doubtless, true that some individuals could never be made as trustworthy as other individuals, no matter how much training is given. When the upper limits are approached, intelligence will doubtless play a very important part. Nevertheless, it is probably true that it is easier to equalize individuals in morality than in intelligence. In moral education, it is extremely likely that an increased amount of training will decrease differences instead of increasing them, as is the case in intellectual education.

VARIABLES IN THE DETERMINATION OF BEHAVIOR

The trait of self-assertiveness will illustrate the second problem in the stability of character. The immediate environment seems to have a great influence upon the manifestation of this trait. A person who is quite self-assertive toward his inferiors may at the same time be quite submissive toward his superiors. How then shall the degree of self-assertiveness be determined? Shall the situation presented involve superiors, equals, or inferiors, or a composite of all three? Other character traits behave likewise. A person may be scrupulously honest in large financial transactions, but palpably dishonest in very small ones where the consequences of dishonesty are not serious. Another individual may react in a different fashion, being honest in small matters but breaking down when the temptation is great and the stake large. A person may be truthful in everyday matters, and yet in a crisis be quite willing to lie to save himself. Trustworthiness, honesty and truthfulness cannot be described except in relation to certain prescribed situations or the average of a series of such situations. In fact the manifestation of the character trait is peculiarly a product of the individual and his environment. As a consequence, prediction of character reactions will be more uncertain than prediction of intellectual reactions, if only because of the presence of the additional variable. The ideal character measure, therefore, would be one that determined not merely whether or not a person is honest, but how honest he is—how far through a series of provoking situations he can go without “breaking down,” or perhaps how trivial the situation must be before resistance “breaks down.”

SPECIFICITY OF CHARACTER TRAITS

Is an individual who is trustworthy in money matters also intellectually honest; is he trustworthy in keeping en-

gagements, performing allotted tasks, etc.? Is a person who is neat in dress also neat in his writing, in the care of his room or his desk? Evidence seems to point to a high degree of specificity of intellectual traits, and suggests a similar situation in regard to character traits, although comparison between these two realms is obviously difficult. A survey of the tables furnished by Voelker shows considerable fluctuation in trustworthiness from test to test, but it is not easy to express this fluctuation numerically. Certain of his calculations are suggestive. While he finds that the correlation between performance in the tests and the judgments of instructors about the character traits of the individuals is almost $+ .60$, the average correlation between the best tests and the first three tests was only $+ .28$ and the average correlation between the first three tests and the total score was only $+ .48$. Each test, therefore, appears to measure something specific, so that it would not be safe to economize time and labor by reducing the number of tests.

The studies of confidence and suggestibility certainly show a high degree of variability from one situation to another. Trow⁹ measured the degree of confidence of forty-two people in reacting to sixteen situations. These forty-two persons were ranked in the order of their confidence separately for each of the sixteen traits. Thus, the degree of confidence of any person in any given test may be expressed in terms of his standing in the group of people, and the variation or shifting of his confidence as the situation changed may be inferred from the variety of positions he occupied in the different tests. Table XXIX shows the range of positions occupied by each of the subjects in the sixteen tests, the maximum range being, of course, from 1 to 42. The average range from the greatest to the least confidence is over thirty positions or points. "Any test of confidence,

⁹W. C. Trow, "The Psychology of Confidence," *Archives of Psychology*, No. 67 (1923).

then, which does not cover a wide number of situations is futile, as an indicator, and its predictions will as likely be wrong as right. The traits are not constants, but vary with the varying situations."

TABLE XXIX. VARIABILITY IN CONFIDENCE

Individual	Range in Confidence	Individual	Range in Confidence
1.....	1.0 to 35.0	22.....	2.0 to 40.0
2.....	1.0 " 37.0	23.....	3.0 " 34.0
3.....	1.0 " 36.5	24.....	14.0 " 41.0
4.....	3.5 " 27.0	25.....	2.0 " 41.0
5.....	9.5 " 34.0	26.....	2.5 " 32.0
6.....	2.5 " 35.5	27.....	2.5 " 38.0
7.....	11.0 " 40.0	28.....	6.0 " 42.0
8.....	4.5 " 35.0	29.....	13.0 " 40.5
9.....	11.0 " 41.0	30.....	14.0 " 42.0
10.....	2.5 " 34.0	31.....	5.0 " 42.0
11.....	5.0 " 42.0	32.....	3.5 " 41.0
12.....	2.0 " 29.0	33.....	1.0 " 37.0
13.....	4.0 " 33.0	34.....	14.0 " 41.0
14.....	13.0 " 40.0	35.....	1.0 " 41.0
15.....	1.0 " 34.0	36.....	1.0 " 42.0
16.....	2.0 " 42.0	37.....	5.5 " 42.0
17.....	1.0 " 33.5	38.....	3.0 " 39.0
18.....	5.0 " 27.0	39.....	1.0 " 41.0
19.....	9.5 " 38.5	40.....	5.5 " 41.0
20.....	1.0 " 37.0	41.....	4.5 " 36.5
21.....	11.0 " 41.0	42.....	4.0 " 42.0

This great variability makes it difficult to express the average degree of confidence of a single individual in the form of a single score. It should be remembered, too, that this experiment measured confidence in the quality of performance in a variety of *test* situations, and consequently gives only a hint of the variation that might be expected in *everyday* situations. Findings very similar to this have been found for suggestibility.¹⁰

¹⁰ W. Brown, "Individual and Sex Differences in Suggestibility," University of California Publications in Psychology, Vol. II (1916), No. 6.

The three facts about character traits, namely, their susceptibility to change through training, their dependence upon attending circumstances and their highly specialized nature, offer serious although not insuperable difficulties in the way of their measurement for practical vocational purposes. There is a further difficulty in the standardization of the tests growing out of these facts. It has been customary to check performance in the tests against known character traits and to adopt those tests which show conformity with the facts of behavior. The great difficulty of getting groups of people who truly represent the varying grades of the trait has impeded progress in character measurement. Low correlations between test performance and behavior may be due to the fact that the tests are poor measures, but also to the fact that the group of people on whom the tests have been standardized are poorly evaluated. For it happens that human judgment is involved just where it is subject to the greatest errors, as indicated in an earlier chapter. For this reason it may be found advisable to standardize character tests by measuring a large sample of the population, distributing them according to the degree to which they possess the trait, and then state any individual's score in terms of the portion of the population that he represents. One might then be said to be as honest as the most honest tenth of the population, as neat as the average of the population, etc.

When an amount of time and energy equivalent to that given to the standardization of intellectual measures shall have been spent on character measurement, practical vocational tests can be confidently expected. The uses to which they will be put need scarcely be mentioned. Everywhere they will supplement the tests of intelligence and special abilities. In the higher and more complex vocations where the intelligence tests are not diagnostic, although they are invaluable for establishing minimum levels, it may well be that character tests will disclose the traits that are significant for

success. Downey describes a few occupations of this sort in terms of her own test as follows:

The executive requires high speed of movement and decision, freedom from load, motor impulsion, reaction to contradiction and opposition, finality of judgment. Interest in detail and perseverance are not essential and perhaps are detrimental.

The research man requires a high degree of perseverance, interest in detail, a slow and critical judgment with a tendency to revise decisions, lack of freedom from load, difficulty in shifting from one thing to another. Flight of time should not impress him unduly.

These are merely suggestive of the sort of analysis that will be put to effective use in discovering vocational aptitude when the instruments for their measurement are at hand.

THE MEASUREMENT OF INTEREST

Interest, although an ill-defined term, stands for a psychological phenomenon closely related both to character and intellectual capacity. Its relation to special capacities is clearly indicated by Woodworth¹¹ in his *Dynamic Psychology*: "Native capacities differ from instincts in that they do not provide ready-made reactions to stimuli. We do not expect the musically gifted child to break out in song at some special stimulus, and thus reveal his musical gift. We expect him to show an interest in music, to learn it readily, remember it well, and perhaps show originality in the way of making up pieces for himself. His native gift amounts to a specific interest and an ability to learn specific things. The gifted individual is not one who can do certain things without learning, but one who can learn these things very readily." Interest appears then to be an integral part of special gifts. It is neither the result of the possession of a special capacity nor the cause of it, but is correlated with

¹¹ R. S. Woodworth, *Dynamic Psychology* (Columbia University Press, New York, 1918).

it. The relation of interest to that driving power which is such a vital component of character, manifesting itself in perseverance, aggressiveness, reaction to obstruction and the like, is hinted at in the following paragraph from the same author: "There is one factor still unaccounted for, and that is the absorption of the child in the subject-matter for which he has a special gift. This state of absorption, whether in the child or in the adult, is worthy of our attention in connection with the matter of drive; for it certainly appears that the person who is absorbed in his task is being carried along by the interest of that particular task. . . . Unless you get up an interest in a system of activities, you can accomplish nothing in it. Extraneous motives bring you to the door of a system of activities, but, once inside, you must drop everything extraneous."

THE STABILITY OF INTERESTS

Not all our interests are native ones attached to our special native capacities; these may be expanded and modified and new ones developed as acquaintance with the world of objects widens, for "every object that is sufficiently novel to cause some difficulty of apprehension, while still within the power of our trained powers of perception, is an interesting object to us, and we are driven to apprehend it by the impulse to surmount the difficulty that it presents." From the practical point of view it is pertinent to ask: How stable are our interests? Are they sufficiently permanent to justify their measurement for vocational purposes? Such questions can be answered only through investigation. The results of two such studies, quite different in character, although not entirely conclusive, furnish tentative answers to our questions. Thorndike¹² measured, in one hundred college students, the

¹² E. L. Thorndike, "The Permanence of Interests and Their Relation to Abilities," *Popular Science Monthly*, Vol. LXXXI (1912),

permanence of interests in subjects of instruction through elementary school, high school and college, by having them report the order of interest at these different periods. The relations between the interests at the different periods, expressed in terms of coefficients of correlation, are as follows:

Relation of Elementary School Interests and High School Interests	.85
Relation of Elementary School Interests and College Interests	.66
Relation of High School Interests and College Interests....	.79

Although it is difficult to allow for the errors that may enter into such retrospective reports, the findings seem to indicate a fairly high degree of stability in such interests. "Even if the true resemblances are 10 per cent below, these facts witness to the importance of early interests. They are rather stable features of an individual's constitution and are symptomatic, either as cause or effect, or both, of abilities."

The second investigation by Poull¹³ has a more direct bearing upon vocational problems. She inquired into the feasibility of directing the careers of students in the fifth to the eighth grades in school on the basis of their interests. How permanent are such interests at this age? About 1,200 children were asked to indicate their first three choices from a list of 69 occupations, by answering three questions:

Which of these would you like best to do? Mark it 1.

Which of these would you like next best to do? Mark it 2.

Which of these would you like next best to do? Mark it 3.

At the end of six months the same procedure was repeated on one of the grades and the two sets of choices were com-

pp. 449 ff.; and "Early Interests: Their Permanence and Relation to Abilities," *School and Society*, Vol. V (1917), pp. 178 f.

¹³L. E. Poull, *Interests in Relation to Intelligence*, Ungraded (1922), Vol. VII, Nos. 7, 8 and 9.

pared. In two-thirds of the cases the first choice persisted, in two-thirds the second choice persisted, and in one-third the third choice persisted. "The conclusion seems to be justified that the first choice as expressed by the questionnaire used in this investigation is an indication of persistence of interest sufficient for the needs of a group investigation. In the actual placement of children, it would be advisable to leave the arrangement flexible enough for a change at the end of a term. The method could be used advantageously as a first approach to the subject of vocational orientation, and the fact that this degree of reliability is found in the first half of the sixth grade, in a spontaneous reaction, without the stimulation of previous discussion or preparation for the response, seems to indicate that at this stage of development, if not earlier, the child mind is in a receptive state for information, discussion, and actual experimentation in the field of vocational enterprise."

DOES AN INDIVIDUAL KNOW HIS OWN INTERESTS?

Interests would have their greatest application in vocational psychology as indicators of ability, provided a person knows his own interests, and provided the relation between interest and ability is sufficiently close. It would only be necessary then to obtain a report of the line of work in which he is most interested in order to know the work for which he is best fitted. Does one really know his own interests? Interest in specific things and activities is inseparably bound up with knowledge of these things and activities. One cannot know whether he is interested in a vocation unless he knows what that vocation will demand of him. A superficial knowledge of an occupation is sure to engender an uncertain and unstable interest in it. The child who wants to be in turn a butcher, a policeman, and a street-car motorman is basing his interests on insufficient grounds. Likewise, many a college student in choosing the career of

law, medicine or the ministry is acting on insufficient knowledge, and his interest may be directed to what will turn out to be a spectacular but a minor aspect of the work. Hence his interest will shift. No short-cut means of furnishing such information has been discovered. The preparation and publication of descriptions of jobs after a careful job analysis, consultations with vocational counselors, the delivery of lectures by eminent men upon the nature of their professions (a device frequently employed with college students), short trials of different occupations commonly provided in the trade schools, all are likely to give an inadequate or one-sided view of the actual nature of the work. If interests are to be relied upon for vocational guidance and selection for specific kinds of work, these devices must be improved or better ones conceived to meet the need. Broader interests may be, doubtless, more confidently relied upon. Thus one may know that he is more interested in dealing with people than with things, in other words, that his social interests predominate, or that he is fond of travel, or that he loves to invent things. Work may, therefore, be profitably classified on such broad interest bases.

The psychoanalyst has an interesting solution of this and other problems that are puzzling the vocational psychologist. He dismisses the services of all vocational experts as harmful meddling and leaves the individual to the infallible guidance of his Unconscious. The "unconscious motives" manifest themselves as conscious interests which should be followed unhesitatingly. A sample of their argument follows:

Every activity or vocation not directed to sex in the broadest sense, no matter under what guise, is a form of sublimation. Nor is the form of sublimation followed by the individual a matter of accident; in other words, is the selection of a vocation a matter of chance, or is it governed by definite laws? The average person seems to consider the selection of a vocation accidental or at least something that is quite impersonal. He

usually assumes that given certain qualifications, physical or mental, or both, a person could undertake any kind of work or vocation. This view is evidently held by parents who usually think they are best qualified to select their children's vocation, and by professional vocational guides who have reduced it all to a sort of mathematical formula. They examine the person, discover some of his attributes and then feel presumptuous enough to tell him what he is fitted for. Such procedure may be good enough for defective persons whose power of sublimation is poor in any case and whom a certain amount of suggestion can influence at least for a time. But does a normal person need such advice and does such advice help him? Investigation shows that the normal individual needs no advice or suggestion in the selection of a vocation, he usually senses best what activity to follow, and what is more, he is invariably harmed if advice is thrust upon him by a person of authority. For it is known that all our actions are psychically determined by unconscious motives, that there is no psychic activity which does not follow definite paths formed in the individual since his childhood, and as work or profession is nothing but a sublimating process in the service of hunger and love, we may assume that it also must be guided by the individual's unconscious motives.³⁴

RELATION BETWEEN INTEREST AND ABILITY

The relation between interest and ability is one of the outstanding problems in vocational psychology in spite of the fact that valid interest in vocations presupposes a knowledge about them which is difficult to provide. Prediction of ability from interest depends upon the existence of a close relation between them. Furthermore, such a relationship would permit of prediction of interest from ability as well as vice versa. Consequently, with the growing efficiency of measures of ability it would be possible to predict the direction of interest after the nature of the special capacities has been discovered. From the conception of interest presented

³⁴ A. A. Brill, *Fundamental Conceptions of Psychoanalysis* (Harcourt, Brace and Co., New York, 1921), Chap. 13.

at the beginning of our discussion it should be closely correlated with ability. To quote from Woodworth:¹⁵

As a matter of fact human interests keep pace with human capacities. Almost always, where a child displays talent, he also displays interest. . . . Along with capacity for music goes the musical interest; along with the capacity for handling numerical relations goes an interest in numbers; along with the capacity for mechanical devices goes the interest in mechanics; along with the capacity for language goes the interest in learning to speak; and so on through the list of capacities, both those that are generally present in all men and those that are strong only in the exceptional individual.

The experimental studies of this relationship have tended toward confirmation of this view. Thorndike¹⁶ found a relation between one's opinion of his relative ability and his opinion of his relative interest in his studies in elementary school, in high school and in college indicated by a coefficient of correlation of $+ .89$. Furthermore, he found a correlation of $+ .66$ between elementary school interests and ability in college work, suggesting the possibility at least of predicting ability in special lines of college work from interests in similar work of earlier years. Bridges and Dollinger¹⁷ measured the relation between interest in college courses evaluated subjectively by ranking of courses, and grades made in these courses by 500 students. The correlation that they obtained was quite low, namely, $+ .22$, and led them to conclude that "a person's relative interests are an extraordinarily inaccurate symptom of his relative abilities." After

¹⁵ R. S. Woodworth, *Dynamic Psychology* (Columbia University Press, New York, 1918), p. 74.

¹⁶ E. L. Thorndike, "The Permanence of Interests and Their Relation to Abilities," *Popular Science Monthly*, Vol. LXXXI (1912), p. 449; and "Early Interests: Their Permanence and Relation to Abilities," *School and Society*, Vol. V (1917), pp. 178 f.

¹⁷ J. W. Bridges and V. M. Dollinger, "The Correlation between Interests and Abilities in College Courses," *Psychological Review*, Vol. XXVII (1920), pp. 308 f.

an examination and reinterpretation of the data on which these conclusions rested, Thorndike¹⁸ reported that, if certain errors were allowed for, the coefficient of correlation would rise from $+0.22$ to about $+0.70$, making these results comparable with his own, and giving a reasonable basis for prediction. Little has come from the purely laboratory¹⁹ studies of this problem, mainly because of the difficulty of engendering any considerable range of interest in the operations by which the differences in ability are measured.

Fryer,²⁰ while acting as vocational counselor, obtained evidence concerning the degree to which the intelligence of the worker is suited to his work and also the degree to which this relationship would change if the worker were to shift to the work in which he expressed the most interest. He measured the intelligence of candidates for change of position, and checked this intelligence score against the distribution of intelligence within the occupation engaged in at the time, also against the distribution for the occupation desired. A discrepancy of 25 points of score (Army Alpha test) either above or below the median was interpreted as maladjustment of the worker. It will be recalled in this connection that one may be maladjusted through too much as well as too little intelligence. Calculating maladjustment in this fashion, he found that 53 per cent of his cases were maladjusted through having more intelligence than required and 7 per cent through having less, making a total maladjustment of 60 per cent. If now the desired jobs are considered in-

¹⁸ E. L. Thorndike, "The Correlation between Interests and Abilities in College Courses," *Psychological Review*, Vol. XXVIII (1921), pp. 374 f.

¹⁹ For the results of such a study see J. F. Dashiell and R. Hartman, "An Experiment to Determine the Relation of Interests to Abilities," *Psychological Bulletin*, Vol. XVI (1919), pp. 259 f.

²⁰ D. Fryer, "Intelligence and Interest in Vocational Adjustment," *Pedagogical Seminary*, Vol. XXX (1923), pp. 127 ff.; for related material see D. Fryer, "The Significance of Interest for Vocational Prognosis," *Mental Hygiene*, Vol. VIII (1924), pp. 466 f.

stead of the jobs actually held, the maladjustment in the way of too much intelligence drops to 36 per cent, and in the way of too little intelligence rises to 15 per cent, making a total maladjustment of 51 per cent. The author rightly attaches no particular importance to the difference between these two totals, but points out the large size of the discrepancy in both cases. It is interesting to observe that to adopt the desired occupation would increase the number of cases of deficient intelligence. This is, doubtless, merely the result of the desire to better one's position rather than the result of a tendency to overrate capacity. It is not an easy matter to extract the effect of interest from the other factors in this study. It is not known, for instance, to what extent any individual is in the occupation to which pure interest would have directed him, nor is it known whether interest in the desired occupation is anything more than a wish to make more money, to have shorter hours of work, or just to get a change. The interests that are assumed to be related to capacities are far more fundamental than such superficial ones as these.

OBJECTIVE MEASUREMENT OF INTEREST

In the light of the importance of interest as a factor in success, it is natural that attempts should be made to escape the errors to which judgment and opinion are liable, in the realm of interest as well as elsewhere, and to devise objective measures of interest. Efforts have been made to infer interest from the reactions which occur under controlled conditions. Some form of the correlation method is usually employed so that the performance of a group of persons in the test can be checked against their demonstrated interests. A test has been devised in this fashion by Freyd.²¹ It con-

²¹ M. Freyd, "The Measurement of Interest in Vocational Selection," *Journal of Personnel Research*, Vol. I (1922), pp. 319 f.

sists of an elaborate questionnaire containing a large number of specific situations for which the candidate expresses like, dislike or a neutral state of feeling. A few sample statements follow in which "L" means "like," "?" means "neutral" and "D" means "dislike":

Draw a circle around one of the symbols after each of the items below:

Fat men	L	?	D
Feeble people	L	?	D
Nervous people	L	?	D
Solitaire	L	?	D
Picnics	L	?	D
Football	L	?	D

The value of each of the questions or statements as part of the questionnaire has to be determined empirically and many were, of course, tried that were found useless. The author defends his method as follows: "If an interest questionnaire, treated with the proper statistical methods, and evaluated with reference to its capacity for discriminating between those who succeed and those who fail in a given industrial task, can be scored in such a way as to make this discrimination numerical and employable in guidance, no theoretical considerations need disturb the psychologist."

The test when applied to 59 men, 30 of whom were studying for mechanical occupations and 29 of whom were preparing for salesmanship, discriminated perfectly between the two groups. The distribution of the two groups on the basis of their scores in the test is shown in Figure 27. Whether the questionnaire method can be applied with equal success to other occupations remains for further experimentation to disclose. The two occupations studied in this experiment probably offer the most favorable circumstances for the success of the method, as they represent the contrast between social and mechanical inclinations.

Burt²² tried four objective tests of interest on a group of students in Agricultural Engineering and correlated performance in the test with standing in the school. Only one of the tests appeared to offer any promise of value. This was essentially a test of the distracting power of ideas in which one is assumed to be interested. The task set for the individual consisted in checking as rapidly as possible a num-

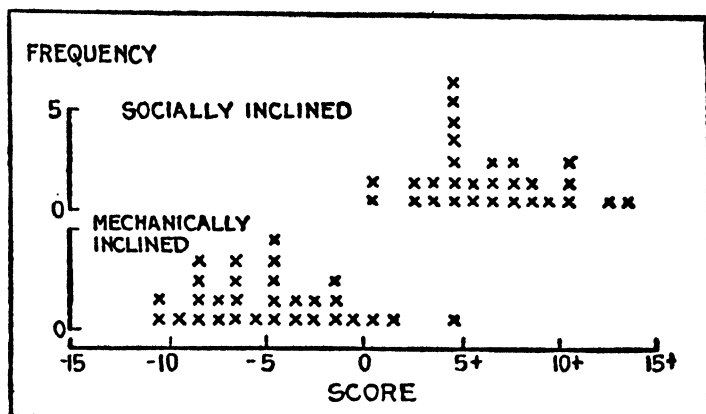


FIG. 27. DISCRIMINATIVE VALUE OF AN INTEREST TEST

ber of meaningless words which were scattered at random through a paragraph of "interesting" material. The distracting power of the "interesting" material was calculated from the difference between the speed of reading such a passage and a "non-interesting" one. The greater the delay caused by the "interesting" material the greater the interest. It would be only necessary to choose passages representing different brands of interest in order to make a proper diagnosis. The test yielded correlations between known interest and interest shown by the test of $+0.25$ to $+0.30$, when the

²²H. E. Burt, "Measuring Interests Objectively," *School and Society*, Vol. XVII (1923), pp. 444 ff.

factor of ability was ruled out. Although this correlation is too low to be of service, the distracting power of interest is a genuine phenomenon and may furnish the nucleus for a useful type of test.

This survey of interest shows that the relationship between ability and interest is sufficiently close to make its measurement a matter of great consequence. It suggests further that for immediate application to vocational guidance and selection the subjective report of interests must be relied on. The most hopeful prospect at present is to find some ready means of disseminating accurate and comprehensive information about occupations so as to furnish a real basis for the expression of interest.

CHAPTER XVIII

INDUSTRIAL PSYCHOLOGY: I. PSYCHOLOGICAL FACTORS IN OUTPUT

A CONVENIENT but arbitrary distinction is usually drawn between vocational psychology, industrial psychology and business psychology. The first has to do with the selection and guidance of individuals into the occupations which will be most appropriate both for the worker and for his employer. The second has to do with the activities of the worker in respect to all the factors that make for maximum return for the labor expended. The problems of business and industry are indistinguishable in this regard and there is no point in dealing with them separately. The third has to do with the psychological problems which arise in the distribution of commodities to the consumer, his needs and desires, and the resistances and obstacles to be met in offering means for their satisfaction. The problems of industrial psychology as thus defined will be the topic of this and the two following chapters.

The fundamental purpose underlying industrial psychology, as well as industrial engineering generally, is the increase in efficiency of all operations. For many years industrial problems were attacked from the strictly engineering point of view where the concept of efficiency was relatively simple and the factors known. In such terms an efficient process is one in which the available results exceed the expenditure. The degree of efficiency of a process is the ratio of available result of the process to the expenditure, and the most efficient process is the one that brings the maxi-

imum return for the least expenditure of energy. In a mechanical operation the available result is measurable in terms of units of the commodity turned out and the expenditure is measurable in terms of mechanical power applied, oil consumed to reduce friction, wear and tear, general depreciation, overhead, etc. The human operator is figured in the equation in terms of amount of his wages to be charged to expenditure.

THE CONCEPT OF HUMAN EFFICIENCY

Along with scientific management there entered into industry the belief that the human element is the costliest element on the expenditure side of the equation, and attention was directed to decreasing costs by increasing the efficiency of the human machine. Such a shift of emphasis implies the complete reorganization of industry, in equipment as well as in point of view. Instead of the individual being fitted into a routine of work, the routine must be modified to conform to the needs of the individual. In the course of this transformation, which has been taking place gradually and is by no means complete, there has been a tendency to carry over the mechanical definition of efficiency to the interpretation of human behavior. Although, in general outline, the definition is the same in both cases, the individual items to be included in output and expenditure are not identical. Neglect of one or more items, either of output or expenditure, will upset the equation.

On the side of output, results can be computed in terms of units of work done, much as in the case of a purely mechanical operation. In computing expenditure, however, serious difficulties are encountered. In the case of a machine the general depreciation or wear and tear to be charged per unit of output can be readily computed by knowing the lifetime of the machine and its cost. In the case of the human individual no one has had the temerity to make such

calculations in terms of dollars and cents. Yet the human wear and tear differs considerably with the occupation, if work hazards in terms of sickness, accident and death rate, and if cost of insurance are accepted as indications. Some account of differences in hazard is obviously taken in the adjustment of wages to working conditions, but what an equitable differential rate should be no one knows. To fail to take account of this factor in computing the cost of work is an error which may manifest itself in dissatisfaction in industry. This matter will be discussed in Chapter XX.

Serious obstacles are met in the calculation of human energy expended in doing a given piece of work. Neither in the psychological nor the physiological laboratory have practical means of measuring energy expenditure been devised. It has been customary, in laboratory studies of the efficiency of work, to attempt to keep this energy factor constant by instructing the worker always to "do his best" and to measure efficiency directly in terms of output. The assumption, of course, is that "doing one's best" is a constant, and that the same amount of energy will always be expended in doing it. But numerous recent studies have shown that such an assumption is false, that "doing one's best" is a variable and the energy expended in doing it depends upon the nature of the task, upon the surrounding conditions, how long the work has been in progress, the satisfaction derived, etc. These important matters have been dealt with in Chapter XII.

There is one factor in human efficiency which does not appear at all in the definition of mechanical efficiency. Whatever the nature of one's philosophy of life may be, it would seem that a certain minimum of satisfaction is legitimately due to the worker as a part of the product of his work. This is an item of output quite independent of that satisfaction which is sometimes provided for by management as a means of stimulating output. Occupations differ consid-

erably in the amount of this pure satisfaction that they give. It would be profitable to see the relationship between the degree of hazard of a series of jobs and the degree of satisfaction that they give, although this would be only one of the possible factors. The important matter of creating satisfaction will be dealt with in Chapter XX.

In spite of the difficulties to be met in measuring human efficiency, at least a tentative definition of it will serve as a guide for the study of problems in industrial psychology. The ideal of human efficiency would be *the production of the maximum output of the highest quality in the shortest time, with the least expenditure of energy and with the maximum satisfaction*. Emphasis upon different aspects of this definition will lead to varying results. Management has emphasized increase in quantity and quality of output, labor has emphasized decrease in expenditure of energy. No one has, consciously at least, attached to satisfaction from work the importance that it deserves in the conception of efficiency. It will be evident that these three phases of efficiency are not unrelated. Conditions influencing one phase will affect the others also. Still, from the psychological point of view, they can be dealt with separately to advantage.

RECOGNITION OF INDIVIDUAL DIFFERENCES AS A MEANS OF INCREASING OUTPUT

Gilbreth¹ in her *Psychology of Management* proposes nine principles of efficiency which may for purposes of psychological examination be reorganized into five, namely, Individualization, Specialization, Standardization, Incentives and Welfare. The first of these principles is *Individualization*. Under the traditional forms of management, the "gang" had been the unit of operation. There had been little effort made to select or adapt the individual to a task according to his pe-

¹L. M. Gilbreth, *The Psychology of Management* (Sturgis and Walton, New York, 1914).

culiar fitness. But the same need for recognition of the extent to which each individual differs from every other in all respects in which he has been measured, that has revolutionized education, was observed to have its application to industry. Gilbreth writes:

Under scientific management the individual is the unit to be measured. Functionalization is based upon utilizing the particular powers and special abilities of each man. Measurement is of the individual man and his work. Analysis and synthesis build up methods by which the individual can best do his work. Standards are of the work of an individual, a standard man, and the task is always for an individual, being that percentage of the standard man's task that the particular individual can do. Records are of individuals and are made in order to show and reward individual effort. Specific individuals are taught those things that they individually require. Incentives are individual, both in the case of rewards and punishments, and finally, it is the welfare of the individual worker that is considered without the sacrifice of any for the good of the whole.

Along with this discovery of the individual there goes the recognition of his importance, and the need for adjusting every detail of the work situation to him instead of forcing him to fit into the set pattern of industry. For instance, Gilbreth² says, in regard to fitting chairs to the individual: "Very few people realize that the working girl should be measured for her working chair in which she spends one-half of the time that she is awake during her entire working life. For this purpose we have had test chairs of varying heights made for the girls to sit in, and then have made a chair for each girl, particularly adapted to her and her work. The correct height of chair is determined much quicker and fits much more accurately than does an adjustable chair." The recognition of the individual implies not merely the adjustment of chairs to fit anatomical structure, but the

² F. B. and L. M. Gilbreth, *Fatigue Study* (Sturgis and Walton, New York, 1916), p. 93.

adjustment of the position of levers, the distance and direction in which they are to be moved, the part of the body (right or left hand, right or left foot) that is to move them, the location of raw material supply and of the place for finished parts. These and numerous other details must be treated in a similar fashion in order to make the most of the human factor in production. More fundamental still is the recognition of the individual worker as a factor in management, who should have a voice in determining the general policies governing hours of work, methods of remuneration, selection of foremen, and who should be a joint owner of the enterprise through the purchase of stock or through some system of profit sharing.

SPECIALIZATION OF FUNCTION

The maximum output will be attained, for short periods of work at least, by giving each individual as few functions as possible to perform. There is a tendency for the mental and motor mechanisms to get set for a certain pattern of reactions so that shifting back and forth from one task to another is wasteful of time and energy. The difficulty introduced by such shifting may be experienced by performing a simple experiment with the series of fifty two-place numbers given below.

64	33	72	69
49	38	35	37
62	28	51	39
57	65	30	32
68	41	56	59
74	50	44	31
53	42	36	60
67	58	73	48
25	52	63	54
40	70	47	46
61	26	43	55
71	34	66	27
45			29

First add 17 to each of these numbers and then subtract 17 from each of them. Finally add 17 to the first, subtract 17 from the second, add 17 to the third and continue this alternation of task throughout the list. Quite uniformly it will be found that the mixed series seems more difficult to do, and measurement of the time required will show that it actually takes longer. If the time required for addition and subtraction be averaged and this average compared with the time required for the mixed series, the difference will be the result of the shifting of function, since the operations are the same in all other respects.

The economy which results from simplifying tasks has innumerable applications in business, industry and everyday life. Housecleaning has been shown by actual trial to move more expeditiously if one sweeps all rooms, then dusts all rooms, then polishes all furniture, then arranges all contents, than by the more commonly observed method of sweeping a room, then shifting to the task and tools of dusting, then polishing, then arranging, and repeating the series of shifts for each room. Dishwashing obviously proceeds more efficiently when the collecting task, the scraping task, the washing task, the drying and replacing task are each continuously maintained. Similarly in constructing such simple objects as window screens, it is more effective to do all the sawing first, then all planing, all sandpapering, all joining, all screen-cutting, all stretching and tacking, all finishing and trimming, and finally all painting, than it is to make each screen complete, changing from set to set, task to task, tool to tool and place to place for each screen.

The delay which results from the introduction of many shifts of operation is not merely a temporary inconvenience that will disappear with repetition or training. It is true, of course, that as the time for any operation decreases through training, the time lost in shifting will decrease too, but the loss from the shifting tends to remain a fairly con-

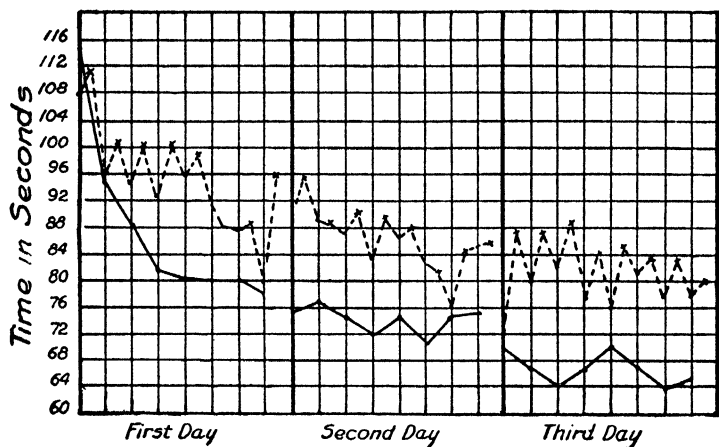
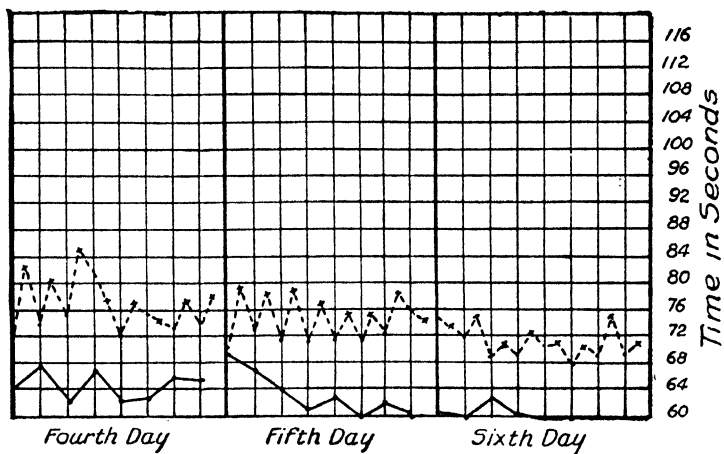


FIG. 28. EFFECTS OF SHIFTING

stant percentage of the total time. One of the outstanding results of time and motion study, to be described shortly, is the importance attached to minute unnecessary shifts of movement or mental attitude. Although the time lost during any one movement may be only a fraction of a second, such a loss becomes extremely large in the course of a day, when the movement is repeated fifteen or twenty times a minute. The interference due to shifting operations is well demonstrated in the experiment of Culler³ with the sorting of cards. He had four groups of persons sort a pack of eighty cards, marked with numbers from 1 to 10, into a box divided into ten compartments marked with the numbers 1 to 10. Two boxes with the compartments differently marked furnished two entirely different sorting arrangements, or codes. The sorting schedules for the four groups of persons were as follows:

³A. J. Culler, "Interference and Adaptability," *Archives of Psychology*, No. 24 (1912).



OCCUPATION UPON OUTPUT

Group I sorted 8 times per day for six days using always the same code.

Group II sorted 16 times per day for six days alternating the two codes.

Group III sorted 16 times per day for six days changing the code every four sortings.

Group IV sorted 16 times per day for six days changing the code every eight sortings.

Thus Group I did not shift its operations at all; Group II shifted 15 times per day; Group III shifted 3 times per day; and Group IV shifted only once a day. All groups sorted the cards according to the one code eight times per day. The only differences among the groups is in the introduction of the second code, hence the effect of the shifting can be determined by comparing the second, third and fourth groups with the first one in regard to the sorting of the first code. Figure 28 gives the complete records for the sorting of Groups I and II. The solid line indicates Group I with no change of code, and the dotted line indicates Group II with the codes alternating. The small dot means the first

code and the small cross means the second code. The records of the other two groups are omitted in order to simplify the chart. The vertical scale indicates the time in seconds required for sorting the pack of cards and the horizontal scale gives the days and the different sorting per day. The curves show clearly that the group that did the shifting always lagged behind the one that did not shift, even after six days of training. The difference is almost as great at the end of the training as at the beginning, which means that when shifts are frequent training does not eliminate the interference and loss of time. Both groups appear to have just about reached their limit of improvement so that it is not likely that a longer period of training would have changed the result. In this experiment, the actual amount of space covered in any one sorting is always the same as in every other sorting. In those industrial operations where the shift involves movement over greater distances—what might be called a spatial shift—there is even less likelihood that the disturbance due to shifting could be eradicated by training.

Although this principle of the maintenance of set or specialization of function has many important applications, it is scarcely necessary to point out that it should be applied, not blindly and inflexibly, but always with due regard for the circumstances and for other principles which may be equally important. Thus, to return to the case of the window screens, it would be a mistake to insist on doing first all screen stretching and then all tacking, since the tools required are the same in both cases and since such shifting would require complete rehandling of every screen. Moreover, such simple facts as that monotony and lack of variety in one's occupation may make for inattention, mind-wandering, accident and ennui, thus incapacitating the worker, cannot be ignored. In fact, the experiment of Culler just quoted furnishes at least a hint that certain large shifts may be beneficial and make for more rapid improvement. If the sorting records on the sixth

TABLE XXX. INFLUENCE OF VARIOUS SHIFTS UPON SPEED OF SORTING

(Roman type signifies Code 1, Italic, Code 2)

Sorting No.	Group I	Group II	Group III	Group IV
1	60.7	74.7	67.0	66.0
2	...	73.3	61.0	61.7
3	58.3	72.0	62.9	59.7
4	...	75.3	60.3	60.7
5	62.7	69.0	79.3	54.0
6	...	71.0	69.4	55.0
7	60.5	69.3	64.6	55.0
8	...	72.3	62.0	55.0
9	57.3	71.0	82.6	71.7
10	...	71.3	70.9	66.0
11	59.5	67.3	67.0	67.7
12	...	71.3	63.6	63.0
13	60.3	69.7	80.9	60.0
14	...	75.0	69.3	56.3
15	60.3	69.3	66.3	58.0
16	...	71.0	63.0	54.0

day for the different groups be compared, it appears that Group IV with only one shift per day makes a better record than any of the others including Group I which has no shifts at all. Groups II and III make records intermediate between I and IV. These data are given in Table XXX. The figures are in terms of seconds required for the sorting. In every case the record for the second code is in italics. The average times for sorting the first code on the sixth day are for the different groups as follows:

Group I, 60.0 seconds; Group II, 69.4 seconds;
Group III, 67.4 seconds; and Group IV, 58.4 seconds.

STANDARDIZATION OF WORK

The principle of standardization as it is applied in industry presupposes the process of analysis by which the job

is broken up into simple units, the examination and measurement of these units and the subsequent combination or synthesis of those that are found to be essential into a new pattern which becomes the standardized procedure. Moreover, in order that the standardized operation may be used by all the workers, proper records of procedure must be kept, and a system of instruction installed by which the worker may be taught the standard method from the beginning. The standardization process is extended to every aspect of the work. Gilbreth uses a list of 119 variables that should be standardized, and states that this list is by no means complete. All these variables may be classed under three heads: first, there are the variables of the worker, such as his strength and endurance, his race, creed, temperament, mode of living, and personal habits; second, there are the variables of the surroundings and equipment, such as the clothing of the worker, the appliances and tools that he uses, the heating, lighting and ventilating arrangements, the rules under which he works, and the rewards and punishments that he may expect; and finally, there are the variables of the motions that the worker makes, such as the direction, speed and length of the movement, the amount of load, inertia, and momentum of the movement. In the perfectly standardized operation all these factors must be measured and the "best" discovered and adopted.

The most spectacular part of this engineering project is the standardization of the worker's motions. By means of motion-picture machines, taking a hundred pictures every second, stereoscopic photography and projection apparatus, and accurate time measuring and recording instruments, a single motion can be analyzed into fifteen or more stages. Wire models showing the path of the movement are frequently constructed, which show clearly the unnecessary part motions and inaccuracies at various stages of the motion. These are eliminated so that the reconstructed motion com-

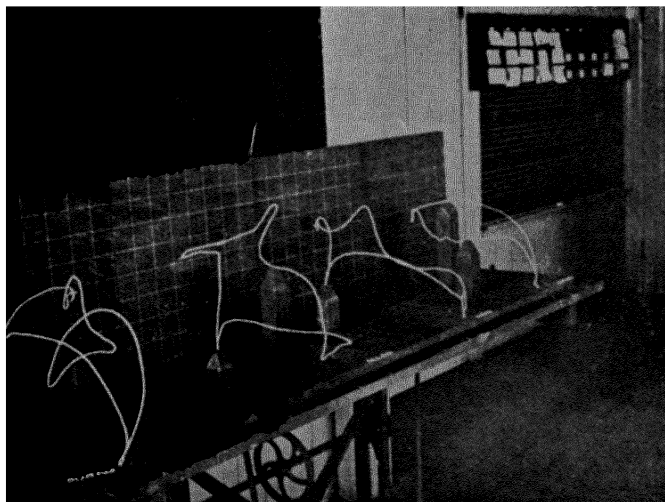
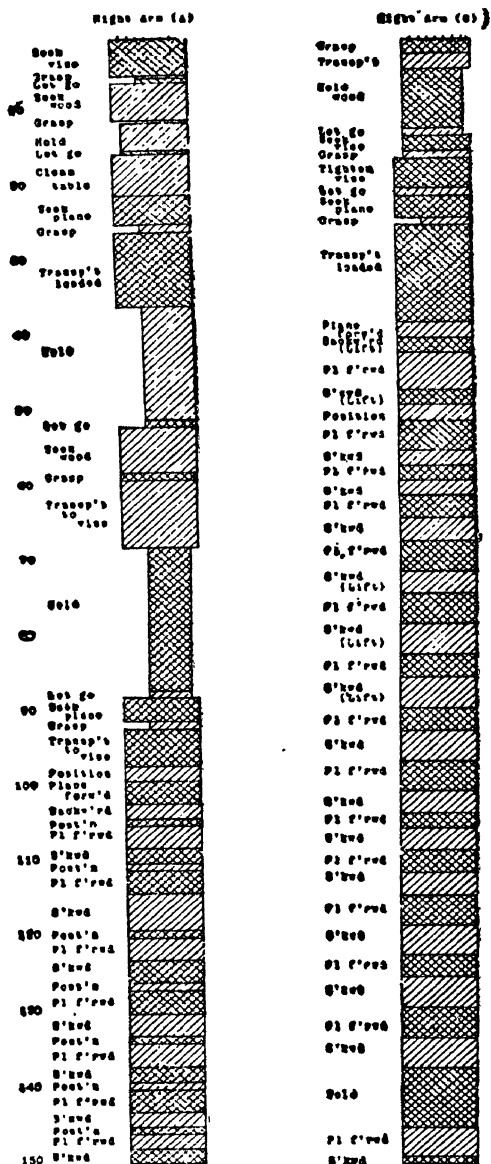


FIG. 29. STANDARDIZATION OF A SIMPLE MOVEMENT



prises nothing but what is essential for accomplishing the desired result. Figure 29⁴ reproduces four such wire models showing, from left to right, the evolution toward the "best" motion of the left hand in working a drill press. The extreme simplicity and smoothness of the last curve compared with the first, together with the elimination of unnecessary starting and stopping, represent a large percentage of time saved.

The type of analysis of movement that is made from motion pictures is illustrated in Figure 30.⁵ This is a simplified motion cycle chart which compares the right arm movements made by two boys in reaching for a piece of wood, transferring it to a vise, tightening the vise, picking up the plane and planing. Both the position of the arm and the time are read directly from the motion picture, so that it is a simple matter to calculate the time required to go from one position to another, the time lost before beginning a motion, etc. It is these times that are transferred to the motion cycle chart. The unit of time which appears on the scale to the left of the chart is one-four-hundredth of a minute. Next to the scale the reactions are indicated by short expressions and abbreviations. The records are to be read downward, the height of the rectangle showing the time spent in the particular act designated. Boy B is much more efficient than Boy A. Both worked the same length of time. B spent about forty units of time in the motions preliminary to planing while A spent about one hundred units. Furthermore, A took an appreciable interval to get his plane into position at the beginning of each stroke, while B had a rhythmical motion which automatically brought the plane

⁴F. B. Gilbreth, *Applied Motion Study* (The Macmillan Co., New York, 1919), p. 90.

⁵Adapted from A. A. Douglas and W. L. Dealey, "Micromotion Studies Applied to Education," *Pedagogical Seminary*, Vol. XXIII (1916), pp. 241 f.

into the correct starting position. These two graphs show clearly how differently such a simple task can be performed and what opportunities there are for saving a large percentage of time in performing it.

Sometimes the changes made are not in the path of movement itself but rather in the arrangement of the worker's body, his materials, tools and equipment. Thus, in Gilbreth's classical study of brick-laying operations, the changes made were mainly in the disposition of materials and in the routing of work. These changes brought up the average number of bricks laid per hour from the traditional standard of 120 to 350 per man, and reduced the number of movements in laying a brick from 18 to 4. Equally striking improvements have been obtained by modification of the surroundings of the worker. The effects of improved lighting arrangements, the installation of proper ventilating equipment and the removal of distractions were given in Chapters X, XI and XII. These matters are beginning to receive serious attention in business and industry. Other environmental changes such as improved washroom, lunching and recreation facilities will, doubtless, have beneficial, though less tangible, effects upon production.

The principles of habit formation underlie the increased efficiency resulting from the processes of standardization. Any form of behavior that is reduced to the level of habit, thereby becoming automatic and free from the necessity of minute voluntary control, is economical of time and effort. And in all cases where the act is to be repeated a large number of times and in just the same manner, as in the case of numerous manufacturing operations, the determination of exactly the correct movement is justified. However, not all industrial tasks fulfill these conditions and hence would not justify the cost of the standardization process.

The psychology of habit formation proves the necessity of a sound system of instruction in standardized operations. A

beginner in any type of skilled work, if not carefully supervised, will inevitably adopt a method which, though it may give the greatest immediate return, is not in the long run calculated to be the most effective. Repetition of such ineffective and faulty work methods establishes habits of performance which not only delay the formation of more appropriate habits, but may positively interfere with their development when an effort is made to acquire them. The very fixity and automatic character of habits which make them so efficient when correct, also make them extremely resistant to change. One of the greatest obstacles that are met in the installation of efficiency systems in industry is due to the resistance encountered in the retraining of old employees. The economical methods of learning that are applicable to industry have been discussed in Chapter IV.

INCENTIVES

The use of incentives as a spur to increased production rests upon a thoroughly sound psychological foundation. Paralleling the growth in our knowledge of the value of such devices, there has been a striking change in their application to industry. The old traditional incentives to fear, punishment and compulsion have given place to the stimulation of initiative, coöperation, loyalty, pride in accomplishment and the proper mental attitude toward work. In one of the most recent industrial movements the slogan, "industrial democracy," means simply that the worker takes a responsible part in his own management, and that the direct incentives, such as ambition, pride, fairness, love of the game, loyalty and social recognition, take the place of the "indirect" incentive of wages, punishment, discharge and necessity.

A recent experimental study⁶ brings out the difference

⁶ E. B. Hurlock, "An Evaluation of Certain Incentives Used in School Work," *Journal of Educational Psychology*, Vol. XVI (1925), pp. 145 ff.

between these classes of incentives when applied to school children. Four groups of children equivalent in capacity were put through a course of training in arithmetic for a period of five days. One group was regularly praised for the "good" quality of its work, another was regularly reproofed for the "poor" quality of its work, the third group was ignored although hearing the praise and reproof administered to the others. The fourth group was trained in a separate room and was free from all these influences. Certain data from these experiments are given in Table XXXI.

TABLE XXXI. INFLUENCE OF VARIOUS INCENTIVES UPON OUTPUT

Groups	DAY				
	1	2	3	4	5
Control	11.81	12.34	11.65	10.50	11.35
Praised	11.81	16.59	18.85	18.81	20.22
Reproved	11.85	16.59	14.30	13.26	14.19
Ignored	11.84	14.19	13.30	12.92	12.38

The different days of practice are shown along the top of the table and the different forms of treatment along the left of the table. The figures are in terms of the score made in the various days' work. Praise was the most effective stimulus, producing a final record nearly 75 per cent better than the control group, about 40 per cent better than the reproofed group, and about 60 per cent better than the ignored group. Reproof was better than no stimulus, and even to hear others criticized made some slight difference. There was no improvement in the control group where no form of "spur" to better work was employed. It is rather interesting that the first application of reproof was as effective as praise, but its stimulating effects wore off in the course of repetition, while the opposite seemed to be the case with praise.

Precautions must be taken in the use of incentives just as in the application of the principle of specialization. The effects of incentive studies in industry are especially likely to be misleading where the results are measured in terms of output alone. As stated previously, efficiency can be properly measured only when expenditure or cost is charged against output. Increased output that is obtained at an excessive cost in the expenditure of energy would not be economical in the long run. Such is likely to be the case in speeding up the highly repetitive processes of industry. When incentives are used to increase the quantity of work done in an ergograph experiment, the added production shows up clearly in the extra time needed for recovery from the work, in which case the incentive does not necessarily increase efficiency.⁷ The proper place to introduce incentives is where there is good evidence that the level of production is below "normal." To attempt to raise output too high by such means as large bonuses, and the like, is liable to produce strain and other signs of injury to health. The human being has many characteristics of a machine, with the result that, when all contributing factors are taken into account, it appears that beyond a certain point the cost per unit of output increases at such a rapid rate as to make the work uneconomical.

WELFARE ACTIVITIES

The final principle of efficiency, known as welfare, will be mentioned here merely as it contributes to increased production. In Chapter XX welfare activities will be discussed more at length as means of creating satisfaction in the worker. Under this head is included the installation of safety devices of all sorts, insurance, fire protection, health examinations, medical treatment, recreational facilities such

⁷ S. L. Crawley, "An Experimental Investigation of Recovery from Work," *Archives of Psychology*, No. 85 (1926).

as libraries, gymnasiums, playing fields, etc. The effect of these upon production will be indirect and hard to compute. There is every reason to believe that a mind free from worry, fear of accident, illness, and the loss of a job will make a more efficient worker. The influence of a healthy and well-nourished body upon output is plain. The effects of worry and distraction are just as measurable in terms of energy expenditure as any piece of productive work. In fact, there is some evidence in medical literature for the statement that worry is more exhausting than productive physical work. Hence any welfare schemes that really accomplish their purpose and deserve the name will make for efficiency. Those supposed welfare devices, however, that so frequently arouse the resentment and antagonism of the worker, will defeat their own end.

CHAPTER XIX

INDUSTRIAL PSYCHOLOGY: II. ECONOMY OF EFFORT

THE reduction in the amount of energy required to produce a given unit of output is quite as great a contribution to efficient work as a direct increase in output. Unfortunately, the means of measuring energy expenditure are complicated and are poorly suited to the measurement of industrial operations. Where they cannot be used, some indirect indicator of energy consumption has to be employed. Many of these have been examined in Chapter IX as measures of fatigue. The most commonly used measure, doubtless, is in terms of output. When as many factors as possible are kept constant, a falling off in output is said to be due to the onset of fatigue or to the progressive consumption of energy available for the purpose. There are two dangers in such an interpretation: first, that there may be a falling off in output merely through the loss of interest or through carelessness; and second, that there may be no falling off in output, when there otherwise would be, because the level of output is maintained through an incentive and at an undue cost in energy consumption. When the introduction of rest periods raises the output, or keeps it from falling, the assumption that the presence of fatigue is responsible for the loss is strengthened, although the case is still not perfectly clear. The effort required to perform a given task is also frequently used as an indicator of energy expended in doing it. In physical activities, at least, effort is evidence of muscular strain, hence to work with greater effort means to work less economically.

ECONOMY THROUGH CHOICE OF CORRECT MOVEMENTS

There are two ways in which the economy of work may be increased: namely, by reducing the effort required by the work itself, and second, by establishing the proper relationship between work and rest. Most important among the factors that make for economy of effort in behavior is the selection of those movements that can be most naturally and most easily made. Some forms of movement are much more easily made than others. For instance, for right-handed persons reactions by that hand are easier and less tiring than those by the left hand. In the manipulation and control of machinery, as in driving an automobile, in handling office devices such as computing machines or typewriters, interesting cases for study are to be found. The typewriter offers perhaps one of the most striking opportunities for improvement in this respect, in part because of its widespread use. Two students, studying the distribution of movements in typewriting on an ordinary machine, found that, out of 37,356 movements, 21,301 were struck by the less efficient left hand and only 16,055 by the more efficient right hand, thus disclosing an inefficient arrangement of the letters. Not only is the work not properly distributed between the two hands, but it is also quite uneconomically distributed among the fingers according to their fitness. When the frequency of appearance of the various letters of the alphabet in current writing and the efficiency of the different fingers are taken into account, the burden carried by the different fingers in typewriting may be expressed in terms of the ideal load for each. Table XXXII gives the figures.¹ The first finger of the right hand carries 135.8 per cent of the ideal load, while the second finger of that hand carries only 58.4 per cent of the load for which it is adapted. The second finger of the

¹ R. E. Hoke, *The Improvement of Speed and Accuracy in Typewriting* (Johns Hopkins Press, 1922).

left hand is overloaded as much as that finger of the right hand is underloaded. The right hand as a whole has lighter duties, and the left hand has heavier duties, than it is capable of performing.

TABLE XXXII. LOAD ON FINGERS DURING TYPING

Finger	PER CENT OF IDEAL LOAD	
	Right Hand	Left Hand
1	135.8	149.3
2	58.4	153.0
3	100.5	73.1
4	30.6	93.9
Average load	81.3	117.3

ECONOMY THROUGH PROPER POSITION OF THE WORKER

Frequently, unusual and tiring movements are necessitated by the improper height or arrangement of working materials in relation to the worker. In one case a slight change in the height and slope of a work-table enabled girls engaged in sorting and filing cards to increase their output by about 50 per cent with no decrease in comfort. In another case small alterations in the operation and arrangement of the machinery decreased working time almost half without increase in fatigue. Many of the spectacular increases in efficiency reported by Gilbreth² are due to just such changes. Figure 31³ affords a splendid illustration of the tiring movements that may be caused by the location of parts of a machine and the slight changes that are necessary to avoid them. They show an operator picking up a bobbin at a winding machine.

² See F. B. Gilbreth, *Fatigue Study* (Sturgis and Walton, New York, 1916).

³ S. Wyatt and H. C. Weston, "Some Observations on Bobbin-Winding" (Industrial Fatigue Research Board, London, 1920), Report No. 8.

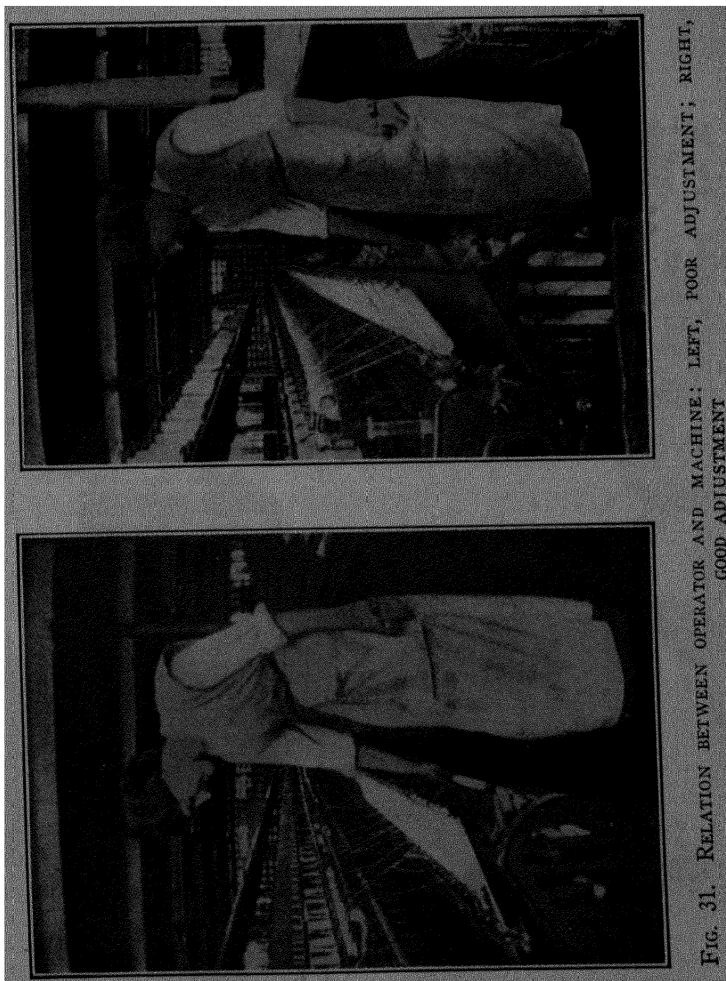


FIG. 31. RELATION BETWEEN OPERATOR AND MACHINE: LEFT, POOR ADJUSTMENT; RIGHT, GOOD ADJUSTMENT

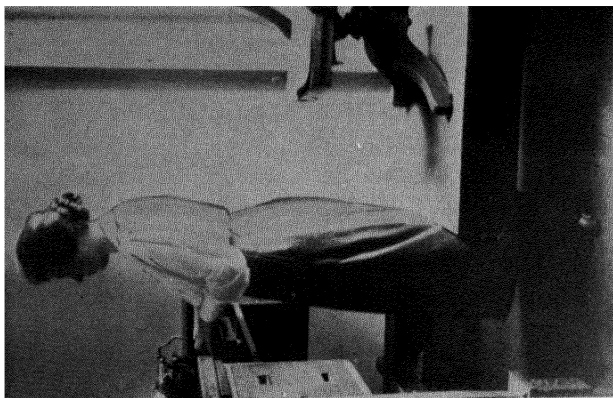
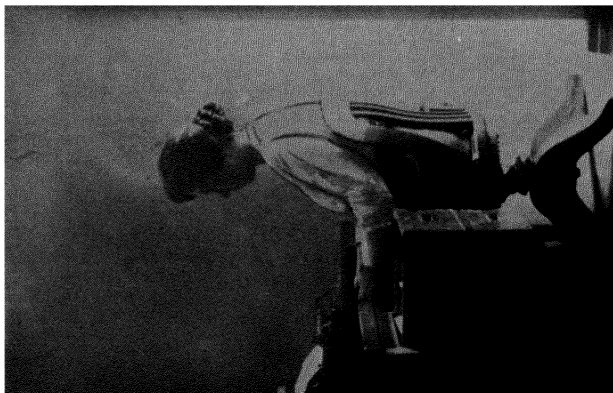


FIG. 32. ARRANGEMENT FOR TYPING: LEFT, WHILE SEATED; RIGHT, WHILE STANDING

In the first, which shows an English machine, the operator has to bend the body at the waist, neck and knees in order to reach the bobbin, while in the second, an American type winder, the same person alters her erect position only slightly to reach the bobbin. A slight readjustment in the arrangement of parts corrects the trouble. This bending of the large structures of the body many times an hour will add greatly to the fatigue of a day's work. Neither machine is what it would be if the operator were taken sufficiently into account in its construction.

Quite as important as the adaptation of the working part of the body to the task, is the comfortable adjustment of the body posture during work. Gilbreth paid much attention to this factor and constructed chairs to place the worker in exactly the correct relation to his work. He recognized, furthermore, the value of a shift of body posture occasionally in order to relieve strained muscle groups, and devised tables and chairs which would permit efficient work while the operator is either standing or sitting. One of the most interesting of such arrangements is the desk and chair, arranged for a typist as shown in Figure 32.⁴ The legs of the desk have been lengthened so that the typist when standing is just at the right height for her work. The chair is fastened upon a small movable platform which makes the sitting height correct. The worker can, therefore, stand or sit as she pleases by moving the platform back and forth. Although no actual data are at hand to show the value of this device it is reported to both increase output and to reduce fatigue materially. The writer is informed that this unique device has not been adopted because of the strength of tradition in favor of the customary desk and chair and the "strange" appearance of the new ones. Strange as it may seem in this age of efficiency, tradition, especially as it concerns the atti-

⁴These pictures were obtained through the courtesy of Mrs. L. M. Gilbreth.

tude of the worker in office and shop, is a serious obstacle to the introduction of improved methods of work.

ECONOMY OF DIFFERENT METHODS OF CARRYING LOADS

One of the most recent and also the most interesting studies of the effect of posture upon energy expenditure was made by Bedale.⁵ This investigator measured energy consumption in terms of pulse rate, blood pressure, and oxygen consumed per horizontal kilogrammeter of work done. This last measure was obtained by means of a portable respiration calorimeter. The worker carried loads varying from 20 to 60 pounds over a circular route 100 yards in length. Although walking was continuous at a fixed rate of speed, the worker was under load only every alternate trip around the circuit. Such an arrangement, as well as the size of the loads carried, was chosen in order to resemble as nearly as possible the regular industrial working conditions. Eight postures, all of them suitable for carrying certain commodities, are indicated in the diagrams of Figure 33, and were as follows:

1. Tray carried in front of the body.
2. Tray carried in front but with the weight taken off the arms by a strap around the shoulders and fastened to the corners of the tray.
3. Weight tied in equal bundles and carried at the sides of the body in either hand.
4. Weight distributed over a board carried on left shoulder.
5. Weight carried in tray on left hip.
6. Weight carried in a rucksack.

*E. M. Bedale, "Comparison of the Energy Expenditure of a Woman Carrying Loads in Eight Different Positions" (Industrial Fatigue Research Board, London, 1924), Report No. 29.

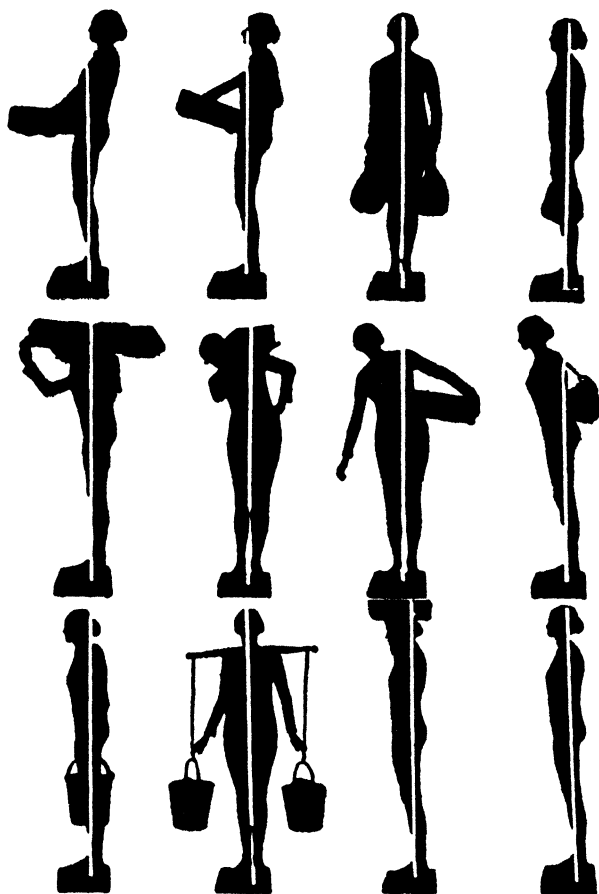


FIG. 33. POSTURES ASSUMED IN CARRYING LOADS

7. Weight divided equally between two pails and carried on a shoulder yoke.

8. Weight carried in a tray upon the head.

Only the data concerning the oxygen consumption for these eight modes of carrying will be given, since the relation

among the different measures is very close. Figure 34 gives these records in the form of curves. The vertical scale is in units of oxygen consumed for each horizontal kilogram-meter of work, that is, one kilogram carried forward a distance of one meter. There is a separate curve for each method of carrying and these are named at the left of the chart. The different loads are shown along the base line of

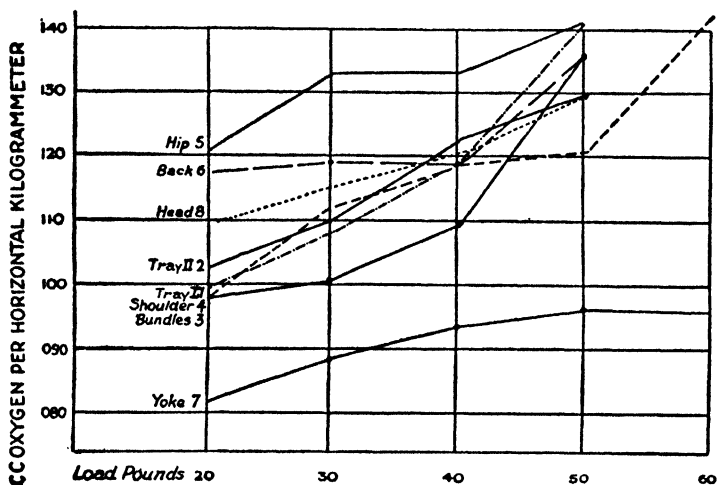


FIG. 34. OXYGEN CONSUMED IN CARRYING LOADS

the chart. The general conclusion is that the method is the most efficient which permits of the most nearly normal body posture, allowing thereby the greatest freedom of the chest action in breathing, interfering least with the gait and creating the least local strain. The relative importance of these several factors is not yet known. The yoke method is by far the best for all loads, as the curve is the lowest for all loads. Inspection of the posture chart shows that the body maintains a normal position by this method. For all the other methods there is a relatively large increase in cost per unit of work at either 40 or 50 pounds' load. Thus the

Tray 1, the Back, and the Bundle method become uneconomical when the load is over 40 pounds, and the Shoulder method when the load is over 50 pounds. The least economical method is carrying on the hip. An examination of the posture chart will bear out these conclusions except for the Bundle method, which is inefficient because of local strain in the wrists rather than in the distortion of posture, and for the Head method, where constriction of the chest muscles was the dominant factor. This experimental study is important because it shows the feasibility of measuring the energy consumption directly while work of an industrial sort is in progress, and also because it shows how complex the weight-carrying problem is, since the efficiency varies not only with the method of carrying but varies considerably with different weights for a given method. For example, carrying in bundles is next to the most efficient method for light loads, but is almost the least efficient for the heavy loads.⁶

DISTRACTION AND INTEREST AS FACTORS IN ECONOMY

Distractions of various sorts that are present in the environment of the worker show their effects more directly in energy expenditure than in decreased output. Hence distractions such as arise from noise, improper lighting, ventilation, discomfort from ill-fitting clothing, etc., may not disclose their ill effects for a long time or at all, because efficiency is measured in output rather than in energy expended. The curious tendency of a person to keep up a certain pace of work in spite of obstacles, which was discussed in Chapter XII, is responsible for the erroneous impression that distractions are not uneconomical. It has been clearly shown that resistance to distraction costs additional effort. For, maintaining one's adjustment to his work in the presence of

⁶ For another study of posture, see H. M. Vernon, "The Influence of Rest Pauses and Change of Posture on the Capacity for Muscular Work" (Industrial Fatigue Research Board, London, 1924), No. 29.

distractions of any sort means a struggle among antagonistic muscle systems and hence waste of energy. A complete list of the distractions to which workers in business and industry are subjected has never been compiled, but such a list should include everything that during the work period competes for the attention. The most damaging distractions have been considered at length in Chapters X, XI and XII, and should be referred to in this connection.

Interest has just the opposite effect from distractions. It is a well-known fact that one can work with less fatigue at what he likes to do than at what he dislikes to do. Examination of the work process in the two cases suggests that where the work is uninteresting a greater amount of muscular work is being done. To say that a certain task is uninteresting means that something else is *more* interesting and distracts the attention of the worker, for as long as a person is awake he is always interested in something. Hence, to make a task interesting is equivalent to removing the distractions represented by otherwise competing interests.⁷ Incentives that produce their effect by creating such interest are economical devices. But it is extremely difficult to find incentives that will make the very performance of the task interesting, that is, that will generate an intrinsic interest. Too often incentives are simply spurs applied from without and produce a superficial interest. In extreme cases, the incentive may become a distraction and defeat its own purpose, as sometimes happens in contests for prizes and promotions. Under ordinary circumstances, however, such as one meets in industry, incentives do increase efficiency, both by raising output and decreasing its cost in energy, because the customary level of performance is far below what it might be with entire safety for the individual.

⁷ For a discussion of the antagonistic relationship between interest and effort, see J. Dewey, *Interest and Effort in Education* (Houghton Mifflin Co., New York, 1913).

ECONOMY THROUGH THE PROPER RELATION BETWEEN WORK
AND REST

The most effective means of reducing the total amount of energy consumed is by establishing the proper relation between work and rest. The conception of fatigue presented in Chapter IX gives at least a theoretical basis for determining the proper work and rest periods. Fatigue sets in when the equilibrium between the processes of waste and the processes of repair is disturbed beyond a given amount. The greater the excess of waste over repair, the greater the fatigue. Work is most economically done when the processes are nearly in a state of balance, while the greater the fatigue is, the greater is the cost of doing a given unit of work. Figure 7 presented a somewhat theoretical curve, showing the cost of doing a unit of work at different stages of fatigue. From this curve it appears that the first half of the work on the ergograph is accomplished with as little accumulation of fatigue as the last 10 per cent of the work, which would mean that a unit of work toward the end of the curve is about five times as costly as one at the beginning of the curve. One cannot argue, of course, from the study of the finger ergograph, to all other kinds of work, for the onset of fatigue differs greatly according to the kind of work, the individual and many other factors, so that only approximations to the most efficient work and rest schedule can be expected. Evidence is sufficient, however, for the conclusion that work should continue only so long as the worker is in the "efficient" part of his curve.

It is not difficult to prove that there is, for a given kind of work, an optimum relation between work and rest, although it requires that a number of combinations of work and rest periods be put to the test. It is customary, as with Gilbreth, to report only the schedule chosen as the most efficient so that the differences among the various schedules

cannot be measured. One study, however, by Shepard* in which all the data are given will serve as an illustration of what can be done. He employed a person to work approximately a nine-hour day at what he called light-heavy muscular work. It consisted in raising and lowering a pair of chest weights—the actual load on each arm being 8.4 pounds—by walking to and from the point of attachment of the device. By this arrangement the muscular system was under load while the weight was being lowered as well as while it was being raised. Although the load was too light to produce muscular strain, it was raised and lowered so often that the worker became sensibly fatigued by the end of the day. All conditions under which the work was done were kept as constant as possible. Conditions of quiet, temperature and humidity were more uniform and favorable than under ordinary factory conditions, and any deviations from good conditions were noted. In one section of his study, the work periods varied in length from 25 minutes to 60 minutes, while the rest period was always 8 minutes.

The results of these different combinations of work and rest are given in Table XXXIII. The first column gives the length of the work period in minutes, the second column gives the length of the rest period in minutes, and the third gives the foot-pounds of work done per hour. It should be noted that when three of the schedules were in operation there was a condition of low temperature and high humidity, to which the author attributes a loss in efficiency. The maximum production was obtained with a work period of 45 minutes and a rest of 8 minutes, when no account was taken of energy expenditure. Essentially the same results were obtained in another section of the experiment where the rest periods varied and the length of the work period remained constant.

*G. A. Shepard, "Fatigue Experiments at Purdue University," *Industrial Management*, Vol. LXII (1921), pp. 281 f; and Vol. LXIII (1921), pp. 354 f.

TABLE XXXIII. THE OPTIMUM RELATION BETWEEN WORK AND REST

Length of Work Period	Length of Rest Period	Average Foot-pounds of Work per Hour
25	8	88,232
30	8	96,880*
35	8	98,237
40	8	97,600*
45	8	98,712
50	8	96,600*
55	8	95,730
60	8	94,823

* Low temperature and high humidity.

The inspection of Figure 35 shows a further interesting and important fact. In addition to a curve constructed from the figures of the table (with slight corrections for unfavorable

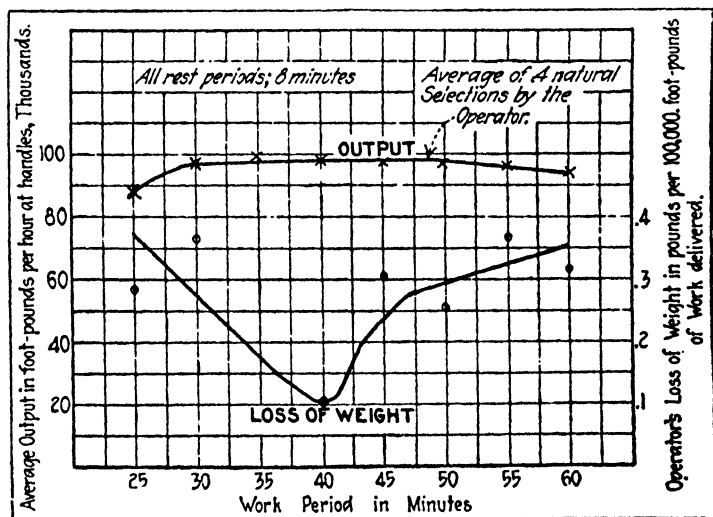


FIG. 35. EFFECT OF DIFFERENT WORK AND REST SCHEDULES UPON OUTPUT AND LOSS OF WEIGHT

environmental conditions as noted) there is plotted a curve showing loss of weight of the worker per unit of work done. From this it appears that loss of weight, which the investigator takes as an indicator of energy expenditure, is not directly correlated with output, but depends upon the relation between work period and rest period. As in cases which we have considered before, the amount of work done is not an entirely safe index of efficiency. Taking loss of weight into account, it appears that the 40-minute work period with the 8-minute rest period gives the most effective schedule. Such is certainly the case where the job is to be continued for more than a short length of time.

It has been concluded from the study that, for light-heavy industrial work of this sort, about one-sixth of the time should be spent in rest. The point that is particularly significant is that the schedule that gives the best results, the optimum program, is not the one that allows the largest proportion of rest nor the smallest proportion of rest, but a relationship between work and rest that lies about midway between these extremes. Exactly the same conclusion is reached in regard to a study of the relation between work and rest in mental activities.⁹ Too much rest is just as uneconomical as too little in both mental and physical work.

The optimum relationship between work and rest is very sensitive to changes in the conditions of the work. The schedule for handkerchief folders which was worked out by Gilbreth and is described in Chapter IX, allowed one-sixth of the total time for rest and was responsible for a large increase in efficiency. But the schedule was found to hold for plain white handkerchiefs only. When black-bordered ones were folded, the onset of fatigue was much more rapid

⁹ See G. E. Phillips, "Mental Fatigue," *Records of the Education Society* (Forbes College, Sydney, Australia, 1920), No. 40.

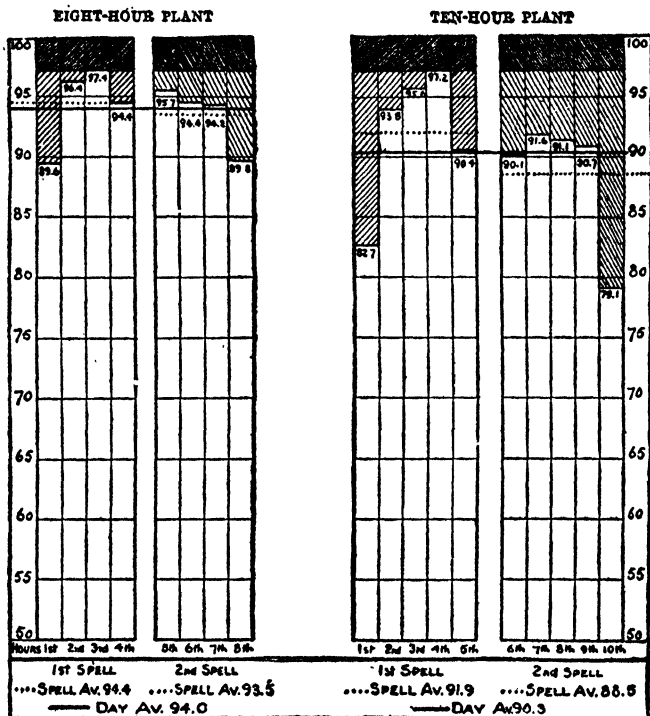
and a still larger proportion of the total time had to be spent in rest. This case affords a splendid illustration of the fatiguing effects of strong contrasts of light and shade, especially when they are moving within the field of vision. Although such work and rest schedules need modification to meet slight changes in material, etc., in order to maintain a maximum efficiency, almost any schedule that introduces rest pauses in long stretches of work will raise the efficiency somewhat. There is little or no danger, outside of the laboratory, of increasing the length and number of rests beyond the optimum.

INFLUENCE OF LENGTH OF WORK DAY

The many studies of output records in the course of a day's work that have been published during the last ten years show a very characteristic output curve. A typical set of such curves is presented in Figure 36.¹⁰ They are derived from two manufacturing plants, equivalent in the nature of their work, except that the first one worked a ten-hour day and the other an eight-hour day. In each plant all the operations were combined to make the one output curve. The figures are in terms of the per cent of the maximum output of which the plants are capable, as indicated by the scale on the left of the chart. The hours of the day are shown at the bottom of the chart. Both curves show a very low output at the beginning of the day, with a maximum output some three or four hours after the beginning of work, with a drop just before the noon hour, and with a still greater drop at the end of the day. The factors that contribute to the shape of this curve are very complex, but it is generally believed that the fatigue factor is one of the most important. The solid line in the chart indicates the average output per

¹⁰ *Public Health Bulletin*, United States Public Health Service, No. 106.

day, while the dotted line indicates the average output per half day. The average output for the ten-hour day is 90.3 per cent of the maximum while that of the eight-hour day is



Limit of possible efficiency (100) = highest output attainable if all operations reach maximum at same hour.

▨ = Difference between limit of possible efficiency and actual maximum hour's output.

▨ = Difference between maximum output and output of each hour.

FIG. 36. WORK CURVES FOR AN EIGHT-HOUR DAY AND A TEN-HOUR DAY

94.0 per cent. The output for the different hours of the day may be read directly from the chart. In every case the average output is higher in the eight-hour than in the ten-hour day. The greatest difference between the two work

schedules is to be found in the first and the last hour of the day. At least two factors are present here. One of them is the residue of fatigue from the previous day, tending to keep down the production, and the other is the definite gauging of output in the light of the length of the task to be performed. These two factors may manifest themselves in various ways, such as delay in getting down to work, a slower rate of work, more frequent stopping, etc. The same two factors are also responsible for the difference in time at which the maximum score is reached. In the ten-hour day the maximum is reached in the fourth hour of work while in the eight-hour day it is reached in the third hour of work.

Such daily output curves have been analyzed by Vernon, who found that, when he divided the first hour and the last hour records each into two half-hour periods, the low records were due to delay in starting work and to premature stopping of work rather than to an actual slower rate of work after it had really been begun. Still, the difference between long and short working days shows itself in change of output, and it makes little difference practically whether this result is due to one cause or another, if both are equally the product of the length of the working day. A reduction of working time by two hours does make considerable difference in the shape of the curve, tending to raise all low points nearer to the maximum.

EFFICIENCY DURING THE WEEK

Very much the same picture is obtained when longer than daily work periods are considered. Although data for weekly periods are scarce, they seem to show a mounting efficiency during Monday with a maximum output on Tuesday, followed by a gradual decline in production until the low point is reached on Saturday. The weekly curve of work

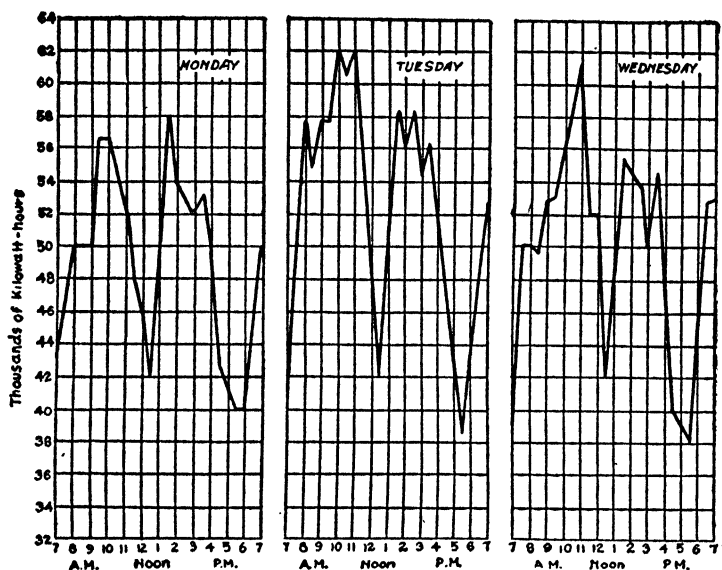
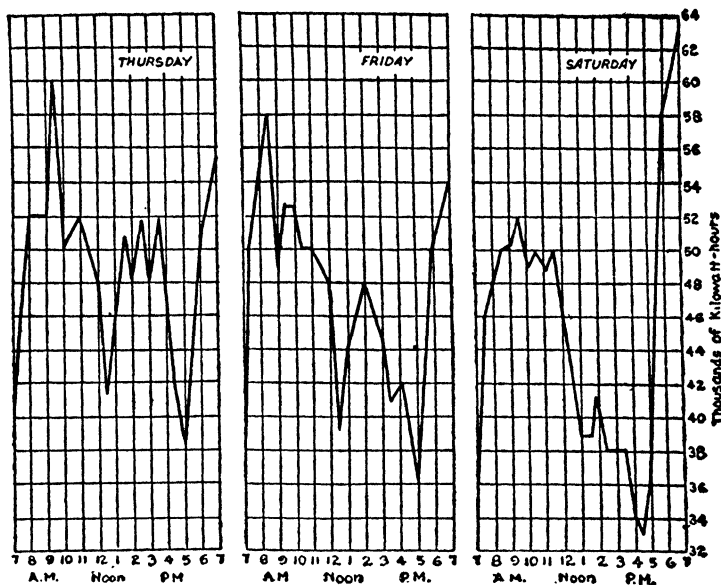


FIG. 37. WEEKLY

reported by Polakov¹¹ and reproduced in Figure 37, shows such fluctuations. The data cover a period of fifty-two weeks, so that each day's record on the chart is the average of fifty-two daily records. Output is measured indirectly in terms of thousands of kilowatt hours of electric current consumed in a large number of industrial establishments. The close relationship between power consumed and output for a group of industries was previously established by measuring samples of both and correlating them. Such a measure of output could be employed only where electric power was used primarily for power purposes. The rise of the curve at the end of each day is obviously due to the

¹¹ W. N. Polakov, "Making Work Fascinating as the First Step toward Reduction of Waste," *Mechanical Engineering*, Vol. XLIII (1921), pp. 731 f.



OUTPUT CURVE

sudden use of current for illumination purposes and should be disregarded. There are no curves available to show the possible variations in this weekly curve that would result from changes in work schedules, but there is reason to believe that beneficial changes in the daily schedule would be reflected in the weekly curve. It might even be profitable to study the weekly curve with a view to improving it directly by means of a suitable work and rest schedule.

Field studies of this nature, lacking the control of conditions that is customary in the laboratory, must be interpreted with caution. There are so many factors that may play a part in changes of production, such as slight differences in the work, temperature, humidity and lighting conditions, systems of payment, and even the character of the workers themselves, that the cause of any change cannot be definitely

established. Some of these sources of error can be eliminated by following the same group of workers through a series of changes in work schedule, because most of the circumstances will then remain the same. Such a field study has been made of light industrial work by Vernon and Bedford¹² in which a special effort was made to prevent varia-

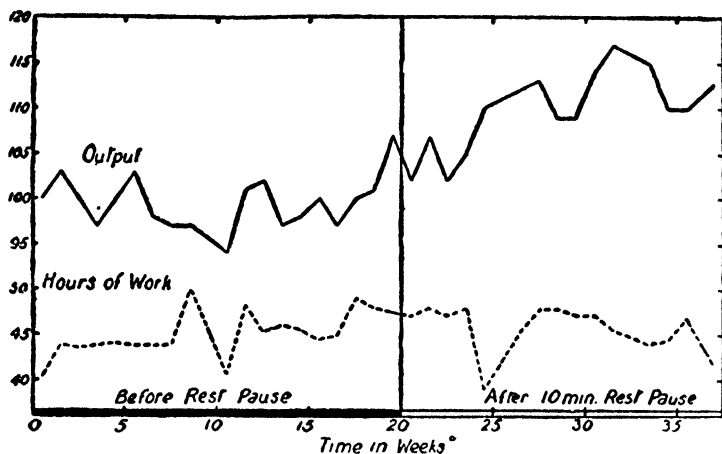


FIG. 38. EFFECTS OF INTRODUCTION OF REST UPON PRODUCTION

tion in working conditions. The most important source of error in such a study as this is the increasing output of workers as the result of practice. They found that, in the case of some individuals and in certain kinds of work, improvement from practice continued over a period of several years. Two typical curves will illustrate the nature of their results. In the first case, a rest pause of ten minutes was introduced into the middle of the morning's work at labeling. The output records of seventeen girls over a period of twenty

¹² H. M. Vernon and T. Bedford, "The Influence of Rest Pauses on Light Industrial Work" (Industrial Fatigue Research Board, London, 1924), No. 25.

weeks without the rest period, are available for comparison with the records of the same individuals over a period of fifteen weeks after the introduction of the rest period. The curve in Figure 38 shows the amount and character of the change. Under the solid line in the figure is plotted the actual working time per week. A comparison of the two curves will show that the fluctuations in the hours worked per week cannot be responsible for the change in the

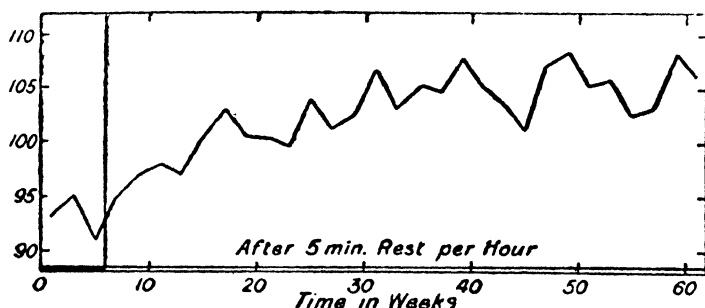


FIG. 39. EFFECTS OF THE INTRODUCTION OF REST UPON PRODUCTION

output beginning at the end of the twentieth week. Although there was an actual loss of about 2 per cent in working time through the introduction of the rest period, there was an increase in the last six weeks of work of 13 per cent in average hourly output over the pre-rest weeks.

In the second investigation, a five-minute rest was allowed at the end of each hour of work at assembling bicycle chains. This is a task requiring a high degree of attention. The records of seven girls were followed for a period of sixty weeks, and at the end of the first six weeks of this time the rest period was introduced. The change which resulted may be seen in Figure 39. In spite of the loss of 7 per cent of working time on account of the rest periods, the average hourly output increased 13 per cent after the change of schedule.

RATE OF ADJUSTMENT TO CHANGE OF WORK SCHEDULE

One of the most significant characteristics of the curves just shown is the slowness of the rate of improvement after work and rest schedules have been changed. They look very much like practice curves. In Figure 39 it appears that a period of twenty-four weeks was required for the output to reach a fairly constant level, which was then maintained for the remaining thirty-two weeks. In explanation of this slow rate of adjustment, the authors say:

"The slowness of the adaptation is due to the fact that, as a rule, it is brought about quite unconsciously. The workers get a little less fatigued because of the rests, and in consequence of their increased reserve of energy they gradually quicken up their rate of production until finally they may fatigue themselves as much as they had done previously without the rests."

This same phenomenon of slow adjustment is especially well demonstrated in a series of changes of hours of work in one of the war industries in England. Output in a moderately heavy lathe operation was followed for a period of ninety-three consecutive weeks.¹³ During this period, "there was no alteration whatever in the conditions of production, other than in the hours of work. Fresh workers were not included in the groups until they had acquired a steady output, and as the great majority of the women of each group were included in succeeding groups, it follows that the data may be accepted as giving a fair index of the productive power of experienced workers throughout the statistical period." Figure 40 shows the nominal working hours per week, the actual average number of hours worked, and the "hourly output." In the case of the "actual hours" and

¹³ H. M. Vernon, "The Speed of Adaptation of Output to Altered Hours of Work" (Industrial Fatigue Research Board, London, 1920), No. 6.

"hourly output" curves, there are given both the original curves (solid lines) and the smooth curves (dotted lines). The left-hand scale is in terms of units of work done per hour, and the right-hand scale is in terms of number of hours per week. The figure shows, in general, that a reduction in the number of hours of work per week was followed

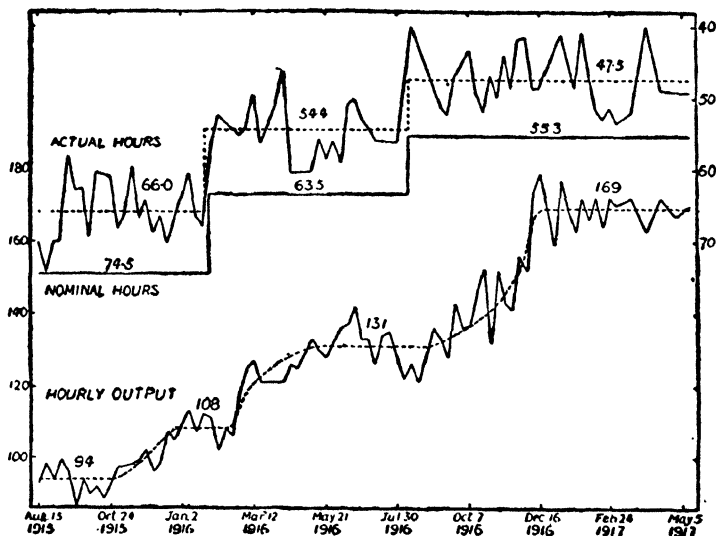


FIG. 40. RATE OF ADAPTATION TO CHANGES IN WORK SCHEDULE

by a period of adjustment covering many weeks. For instance, following the change from 66.0 to 54.4 actual working hours, there was no change from the output of 108 for a period of nearly a month. Then there followed a rising curve of output for about two months until the level of 131 was reached. When the actual hours were reduced to 47.5, there was again a stationary period followed by a rise over a period of about three months to a new high level of 169. The increase in output during the first period of 66.0 hours' work per week, from 94 to 108 units of work, is

attributed, by the investigators, to recovery from the excessively long hours of actual work put in during the first part of the statistical period. The women averaged 71.2 hours per week in the first four weeks, but then they appear to have learned wisdom by experience. Presumably in order to maintain their health they took much more time away from the factory (i.e., kept worse time) and they never averaged again more than 67.6 hours of actual work in any four consecutive weeks.

This process of slow adjustment is the outcome of the tendency to get "set" in a certain pace of work which was so well demonstrated by Morgan.¹⁴ An individual apparently establishes a "convenient pace" which for him uses up in a given work period as much energy as he can recover conveniently, or at least as much as he is willing to spend on the task. When conditions change so as to make more energy available, the old pace hangs on and it takes time to establish the new one which involves a readjustment of mental attitude as well as of muscular reaction. "It is very important that manufacturers should realize the slowness of the adaptation. It is often imagined by them that the improvement comes on immediately, and if, after a trial lasting a fortnight or a month, they find that the output is rather less than before, they are greatly inclined to abolish the change. They ought to allow a three months' trial before coming to a definite decision, and during the trial period no other changes of working conditions should be made."

INDIVIDUAL DIFFERENCES IN IMPROVEMENT FROM INTRODUCTION OF REST

Any one who is thoroughly familiar with the facts of individual differences will expect that persons will differ in their reaction to work and rest schedules. Some people will

¹⁴ See Chap. XII.

undoubtedly improve more than others. This variability among individuals presents an obstacle in the way of the practical application of fatigue data, only in the sense that it sets a practical limit far below the ideal of efficiency. What is usually found is that the introduction of rest into work periods improves the poor workers much more than the good workers. In the study of labelers described earlier (page 386) the workers were divided into three groups, good, medium and poor, according to their performance before the rest periods were introduced. The effects of the introduction of the rest periods upon the three groups were measured over a period of ten weeks, and showed both absolute and percentile differences in amount of improvement as follows:

Best group 9 units or 8.2 per cent
Medium group 13 units or 12.8 per cent
Poor group 15 units or 17.3 per cent

Similar results have been found for operations of tying, bicycle chain assembling, and leather cutting. These changes are apparently not to be explained as different degrees of improvement from practice as all the members of the groups had approximately the same amount of previous training. The authors find support, in their further study, for the view that these groups differ mainly in their susceptibility to the onset of fatigue, and that the poor group without the rest period is forced to work at a level of efficiency where the cost is too great in relation to the return. Thus the introduction of a rest period tends to raise the level of production of the poor group to that of the good group.

This chapter has presented a few samples of what may be done to reduce waste of energy in industrial work through a thorough knowledge of the human mechanism. On the whole there is always one "best way" to perform an act, and it involves both the selection of the part of the body best adapted for performing it and then establishing the most

efficient relation of that part to the work. Furthermore, it is necessary to be acquainted with the curve of work and to so gauge work and rest intervals as to utilize the most economical portions of the curve. It is essential also to recognize that adaptation to changes in work conditions is slow and frequently involves a readjustment of mental attitudes and work habits. Experimental studies have shown that to perform an act faster means not merely greater speed in doing each integral part of that act, but often presupposes an entirely new pattern of reactions. If individuals differ in fatigability, as we know they do, there arises the problem of selecting the proper individuals as well as their adjustment to the work. Such matters as the time of day best suited for different types of work, the utilization of natural body rhythms to the best advantage, the way rest periods can be most economically spent, and the efficiency of shifting from one kind of work to another at intervals are all problems that warrant serious consideration.¹⁵

¹⁵ The whole series of reports of The Industrial Fatigue Research Board (London) published by His Majesty's Stationery Office, and frequently referred to in this and the preceding chapter, offer a great quantity of data on these and other practical problems of business and industry.

CHAPTER XX

INDUSTRIAL PSYCHOLOGY: III. SATISFACTION AS A PRODUCT OF WORK

It is especially important in discussing the satisfaction of the worker to remember that the human being is a whole, that he cannot be split up into parts, such as the factory worker part, the father of a family part, the holiday seeker part. For the satisfactory or unsatisfactory conditions away from work will be reflected in the attitude toward work and vice versa. The spread of satisfaction or dissatisfaction from any cause is extremely rapid and extensive. Many a business man's day can be spoiled because of a mislaid morning newspaper, and many an industrial worker's day can be made unsatisfactory through jealousy, a headache, a family quarrel, or a sick child, as well as by an overbearing boss, a monotonous kind of work or a poorly adjusted work bench. The splitting of the individual into parts leads to false conclusions in the study of output and effort as well as satisfaction. It has long ago been pointed out that a real work and rest schedule for any type of industrial activity must be a twenty-four-hour schedule. The accomplishments of a worker during an eight-hour day depend upon his use of the remaining sixteen hours as well as upon the arrangements of his eight-hour schedule. The quality and quantity of his food, the number of hours of sleep and the character of the recreation that he chooses, all are reflected in his day's work. But the irradiation of satisfaction and dissatisfaction is far greater. It is a characteristic of the feelings to be thus diffuse rather than highly specific—when a person is satis-

fied he is satisfied "all over" and when he is dissatisfied he is dissatisfied "all over."

REMEDIES FOR INDUSTRIAL DISSATISFACTION

Two classes of remedies have been offered for industrial unrest. First, there are those which aim to make the work itself interesting. Innumerable devices have been adopted for this purpose, such as incentives, wage schemes, comfort accessories, beautiful surroundings, opportunities for social intercourse while at work, music, part ownership of the industry, and many others. Second, there are those that are based on the assumption that work as such is inherently unpleasant and always will be so, that the present trend of industry cannot be greatly interfered with, and that frank recognition of the fact is essential. According to this point of view, working hours will be made as short as possible and the returns for work as remunerative as possible. Effort will then be concentrated on creating satisfaction in the non-working hours.

The well-known efficiency system of Gilbreth typifies emphasis upon the first of these classes, while the industrial philosophy of Henry Ford offers the best example of the second. Both types of system recognize the need for manifestation by the individual of his native impulses, his motives and aspirations for self-expression, for ownership, for recognition in the eyes of his fellows, etc. The first would accomplish these ends by allowing scope for originality and inventiveness in the worker by giving him credit for useful suggestions and innovations in connection with his tasks, by arousing competition, rivalry, pride in the quality and quantity of his work, and by making him realize the useful service rendered by the articles that he helps to make. The second would accomplish the same end by neglecting all aspects of industrial work except those that are conducive to high output and high wages together with short hours of

work, allowing all the free hours for the expression of personality. As a concrete suggestion for making this possible there is the decentralization of industry, so as to make possible the ownership of small farms, which can be cultivated during after-work hours. Each family could then become almost entirely self-supporting, with unlimited opportunity for pride of ownership, inventive genius, and for the social instincts to expand and develop according to the capacity of the individual worker. Thus the non-working hours would resemble the life of the worker as it was before the genesis of the industrial era. Some enthusiastic supporters of such a doctrine see the need of education especially directed to the cultivation of the proper means of spending leisure or non-working hours. Such doctrines are likely to lose sight of the natural differences in capacity which interpose definite obstacles in the way of the choice of leisure as of work.

SATISFACTION THROUGH ADJUSTMENT

The greatest hope of satisfaction from work, whether in industry or elsewhere, lies in putting each person into the type of occupation for which he is best fitted. There must be the proper interrelation of the strength of the worker and the strength required of him. The same is true of physical endurance, intellectual capacity, and all other significant traits. Individuals differ in these respects and it is a vital matter to recognize the importance of such differences. The fear has frequently been expressed that, when such adjustments have been made, there will be no one to do the menial tasks. With the introduction of machines to take over more and more of the heavy and routine work, there will, doubtless, be enough persons who will get satisfaction from doing the remaining menial tasks. The study of the interests of people of low mentality and of opportunities for employing them in industry has demonstrated that there are many people who prefer routine, repetitive and menial activities and who

shrink from tasks that are more complex and responsible. Such have been found to make excellent and satisfied general handy men, hotel dishwashers, window cleaners, assistant janitors, domestic servants, laundry workers, assistants to masons and carpenters, laborers, errand boys, cobblers, boot-blacks, chair caners and the like.

Data were presented in an earlier chapter (Chapter XVI) to show the close relation between intellectual capacity and satisfaction from work. Certain jobs were enjoyed most by relatively low-grade mentalities and others by relatively high mentalities. Burnett¹ has shown in a laboratory experiment upon simple repetitive tasks arranged to resemble factory work, that the more intelligent workers disliked the work and found it very tiresome. They made poor production records, although in spurts they showed that they had the capacity to make much higher records. The best record was made by a person of average intelligence, who enjoyed the work and consistently did her best. The least intelligent one of the group, although not making such a good record as the others, kept up a steady output and expressed satisfaction with the job. Thus it appears that monotony, which is a matter of the interrelation of the worker and his work rather than a characteristic of the work itself, can be largely reduced by the proper placement of individuals according to their capacity. In other cases, although it may never be eliminated entirely, much can be done to reduce it by the introduction of frequent rest periods and the shifting of occupation.

SATISFACTION FROM THE EXPRESSION OF NATIVE TENDENCIES

There is a very voluminous literature dealing with the need for expression of instincts in industry, and the way in which modern industry deprives the worker of such ex-

¹I. Burnett, "An Experimental Investigation into Repetitive Work" (Industrial Fatigue Research Board, London, 1925), No. 30.

pression.² Undoubtedly, there are such impelling motives in human nature, and to frustrate them causes dissatisfaction. The manner in which they shall be satisfied is, however, not prescribed by nature, and therein lies a fact of great significance for industrial psychology. There is commonly supposed to be an instinct of curiosity, for example, which may be satisfied in a great variety of ways by different people. For one person it may be appeased by developing a mathematical formula or searching the heavens for a new star, for another, by prying into a neighbor's private affairs or solving a cross-word puzzle. Education is a potent factor in determining what the means of satisfaction shall be, although limits are set for each individual according to his "stature."

As Thorndike³ has pointed out, it is natural for every human being to be active both in body and mind. Such activity gives satisfaction so long as the particular character of it is within the capacity of the individual as to quality, quantity and duration, and does not impose undue strain upon him. Furthermore, there is nothing in nature which demands that such activity shall be useless rather than productive. In fact, it appears that, other things being equal, useful activity gives more satisfaction than useless. The notion that all productive activity is distasteful is contradicted by the fact that many persons choose for recreation just what is the work of others. Automobile driving, gardening, chopping wood, even the digging of ditches, serve both for recreations as well as for jobs. Added to this is the well-known fact

² A few of these are: O. Tead, *Instincts in Industry* (Houghton Mifflin Co., New York, 1918); T. Veblen, *The Instinct of Workmanship* (B. W. Huebsch, New York, 1918); C. Parker, *The Casual Laborer* (Harcourt, Brace and Company, New York, 1920); H. Tipper, *Human Factors in Industry* (The Ronald Press, New York, 1922); H. Chellew, *Human and Industrial Efficiency* (G. P. Putnam's Sons, New York, 1920).

³ E. L. Thorndike, "The Psychology of Labor," *Harper's Magazine*, Vol. CXLIV (1922), pp. 799 f.

that many persons continue their work from the sheer pleasure of it, long after there is any need for the financial return that it brings. Then too, one does not always choose a recreation that departs far from his work in nature. Many a chauffeur on his Sunday off will spend the whole day driving a car. The writer knows of a cook who frequently spent her half holiday preparing a big dinner for her friends. The striking characteristic of recreation as contrasted with work is that it is adjusted in quality, quantity and duration according to capacity.

There is a self-assertive tendency in human nature by virtue of which one gets satisfaction from the mastery of people and things. This does not mean at all that every one needs to be boss of a gang in order to be happy, for such responsibility would be distasteful to some people. But to be "in charge of" something or somebody, to have a degree of responsibility suited to the individual, does give satisfaction. To have a desk, to have only part of a work bench over which one has charge, is satisfying. To be head scrubwoman in a corps of three, where the title implied nothing but length of service, was a source of pride and satisfaction to one individual. The simple device of designating the worker by name as is the case with bus drivers in New York City instead of the customary number, or of displaying the name of bank clerks, store clerks, post-office employees, enables the public to react to those persons in a fashion which is at once stimulating to their self-assertive tendencies and satisfying.

Along with this tendency, but not in conflict with it, is the tendency toward a submissive attitude. To be submissive and loyal toward a person to whom one can "look up" gives as great satisfaction as to be master over another. In institutions of learning, in laboratories, in hospitals, satisfaction is commonly derived from pride in and loyalty to one's superiors. If this reaction is rare in industry, it is due to the

characteristics of the traditional boss who is sure to disappear under able personnel management. Meanness, pettiness, dishonesty and cruelty on the part of a foreman will inhibit any satisfaction which the expression of the submissive tendencies might engender.

Work may create satisfaction through the opportunity for social intercourse. To be one of a group and on terms of good fellowship with its members is a source of great satisfaction. Gilbreth made a special effort to organize congenial groups, by selecting their members according to race, creed and politics. To be one of a group with common interests and purposes constitutes a strong attraction of lodges, clubs and secret societies. The working environment frequently affords the best opportunity for associating with congenial people. More use could be made of these facts in industry. In the experiment of Burnett (page 396) just referred to, the workers sat around a table. On certain days talking was prohibited. Although on such days the production did not decline, all but one of the group hated them. The one who did not object to the silence had the lowest grade of intelligence and felt that the talking interfered too much with her work.

Along with this satisfaction from social intercourse goes an added pleasure when an individual attains some importance or distinction in his group, or at least holds its respect. It is a real torture to become an outcast or a "scab" in relation to one's class, for his standing in the world is determined by his standing in his social class. A butcher is content if he is known as a good butcher—it is no degradation to him to realize that he is not a good surgeon. But let his ability as a butcher be questioned and the reaction is quite a different one. Likewise, the plumber gets his social status among plumbers and does not have to compete with dentists or tool-makers. Even the lowest and most menial jobs in this sense give chance for a feeling of importance

and its accompanying satisfaction. It is said that thieves and robbers have their own codes of behavior, and one who attains distinction among them is not disturbed at the status of his occupation elsewhere. The misery of an occupant of the death house of a prison may be much increased by the disdain of his neighbors.

SATISFACTION AND HAZARD

Few data are available on the question of the relation between dissatisfaction and the hazard of the work. There is good reason to expect, however, that those occupations which are most satisfying would in general be the ones where the hazards are the slightest. There are two reasons why this might be difficult to demonstrate. First, there is at least a partial compensation for extra hazard in the way of increased remuneration so that dissatisfaction might be suppressed. Second, there are some persons who seem to enjoy a large element of risk, as in automobiling, aviation and exploring, but the number of such persons is relatively small. It has been suggested that if occupations were arranged in the order of their hazard and in the order of their dissatisfaction as measured in agitations, strikes, etc., the relationship between the two arrangements would be close. Another way to demonstrate a causal relationship would be to note changes in the hazard of industries and the changes in satisfaction of the workers over long periods of time. The problem would be complicated, of course, by the presence of other changes along with changes of hazard. An interesting table of such hazards and their changes over a period of twenty years has been computed for a series of English industries.⁴ These are reproduced in Table XXXIV. The hazard of each occupation is expressed as a ratio of the hazard of the

⁴E. L. Collis and M. Greenwood, *The Health of the Industrial Worker* (P. Blakiston's Son, Philadelphia, 1921), pp. 73 ff.

ministry, which has the lowest hazard and is given a rating of 100. The derivation of the hazard index is complicated and need not be described. Some industries have risks more than two and a half times as great as others. The amount of change in some industries over a period of twenty years, as in the case of bricklayers and printers, shows that great improvements are possible. No figures for satisfaction in these industries are available.

TABLE XXXIV. HAZARDS OF INDUSTRIAL WORKERS

	1890	1910
Clergy	100	100
Agricultural laborers	119	106
Commercial clerks	172	181
Coal miners	174	164
Brick layers	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
Tinplate workers	187	152
Chemical workers	262	147
Paper making	170	153
Shoe making	173	188
Tailors	186	180
Cabinet makers	184	179
Printers	206	174
Book binders	199	179

The same authors present a few figures intended to show the relation between hazard and satisfaction in English coal mines. The methods of mining and the hazards vary in different districts. These have been compared with the desire for strikes in the different districts, which is taken as an indication of dissatisfaction. The figures in Table XXXV give

merely the order of hazard and the order of dissatisfaction, "1" standing for the greatest amount of each. Although the correlation between these two series of events is not very high, still there is a positive relation.

TABLE XXXV. RELATION BETWEEN HAZARD AND DISSATISFACTION

Mining District	Dissatisfaction	Accident Rate
I	1	4
II	2	1
III	3	3
IV	4	2
V	5	5
VI	6	6

Within the term hazard should be included the uncertainty of employment. There are many aspects of this problem that are economic rather than psychological. But fear of losing one's job, worry for the welfare of a family, and the demoralization of idleness are mental states that play their part in unrest. The evils of seasonal work are generally recognized and the attempts to cure them are meeting with success. In the building trades, for example, the arousal of interest in the possibilities of all-year work and the invention of methods and materials that make such work possible are doing much to create steady employment. The opportunities for the same type of improvement are just as great or greater in other industries. A full recognition of the psychological advantages to be gained, along with the economic advantages that are already thoroughly understood, may help to initiate the necessary changes. The fear of unemployment aroused by the arbitrary exercise of discharge on the part of foremen who do not hold the respect and confidence of the worker can be entirely eliminated by the installation of proper personnel methods.

SATISFACTION OF THE NON-WORK DESIRES

Our attention has been directed thus far to the reactions of satisfaction and dissatisfaction toward work and its conditions. The fact must be emphasized, in addition, that many of the human needs that demand satisfaction are what might be called non-work needs. They are not concerned with the performance of the job, but belong to the home, to recreation, to pleasure, food, etc. The individual worker is no longer the creature of his own desires, for these are merged with those of his family. He cannot limit his comparisons and contrasts so narrowly to the members of his own occupational group as he can while at his job. Take, for instance, the desire for the approval of one's associates. This may lead to a high output for the day's work, a clean work bench, a record free from tardiness in getting to work, but when away from work it will be more evident in the wife's hat, the children's clothes, the parlor furniture, or the pedigree of the family's dog.

As pointed out earlier in this chapter, the means of satisfying human wants are not prescribed by nature, but, on the contrary, are the products of education, either formal or casual. Thus to be hungry is natural, but what one shall eat to satisfy that hunger and how he shall consume it are not predetermined. The desires for these acquired means of satisfying the fundamental wants comprise the purposes and motives of everyday life. Hence purposes change as the environment changes. Although one will persist in getting hungry the desire for bread and cheese may give place to the desire for champagne and cake.

THE EVOLUTION OF WANTS

What are the great educational forces through which our everyday wants are built up? One of the most effective of the casual forces, if not the most effective, is imitation, the

desire to conform, showing itself in the striving to become more like our betters. This is the soul of fashion and causes a continual shifting of our specific purposes. A certain individual finds that his neighbor has purchased a bicycle, and soon he too must have one; then the neighbor buys a Ford car, and again he must have a Ford. The neighbor buys a Buick and the Ford no longer satisfies. So it is with a thousand items of daily life. Emulation continues and the burden of cost rises. The matter would not be so serious if the neighbors were equal in resources as well as in wants. But with the growth of easy means of communication—newspapers, magazines, motion pictures, advertisements, automobiles—all men are in one sense neighbors and know well each other's manner of life. Emulation is restricted not alone to those with like resources but spreads from class to class. For the obvious and superficial "goods" of life, the laborer may have the same desires as the manager, the executive and the owner. The story is told of a negro laborer, who, upon receiving very high wages during the war, crowded two player pianos into his three-room home, and bought oriental rugs so large that they had to be rolled up at one end in order to fit the rooms. But individuals cannot carry out such purposes indefinitely.

Interesting support for these statements comes from an article on the problems of distribution of manufactured goods.⁵ The author says: "Americans have been educated to consume a wide variety of articles in tremendous quantities. Marketing methods with intensive selling and convincing advertising have done this." The following comment is made in a footnote to the article: "Undoubtedly, the characteristics of the American people have made the tremendous development of consumer markets possible. The

⁵ P. M. Mazur, "Is the Cost of Distribution too High?" *Harvard Business Review*, October, 1925.

democratic spirit of the people which is evidenced not only politically, but in material ambitions, makes every one desire what his neighbor has. Emulation has been of great aid to the stimulating force of advertising and aggressive sales methods. But it has been the marketing methods which have converted the potential consumer market into an actual consumer market."

Further evidence of the part played by advertising in leveling desires is furnished by the following quotation.⁶ "If the poster appeals especially to one of the upper classes, if such a term may be used, it would be hard to convince any advertising man that he was not also making converts from the lower ranks. For the state of any man's pocketbook may keep him from getting the object he sees advertised, but it cannot kill his desire for it, and as soon as he does have the money he's very apt to respond to the appeal of the fine posters he has seen." Thus we make the interesting discovery that the intensive and extensive methods applied at the present time to the distribution of manufactured products must be held responsible, in part at least, for the difficulties presented by the human element in the manufacture of these very products. Advertising arouses desires which can be satisfied only by increased purchasing power made possible by higher wages. Unsatisfied desires lead to dissatisfaction. Practical recognition of this similarity of desires for the superficial goods of life and an attempt to satisfy all classes appear in the manufacture and sale of articles of similar appearance but of different quality. On the furniture floor of one large department store, for example, one will find some chairs costing one-fifth as much as others but quite similar in appearance. Lofty desires may thus be satisfied with a lowly purse, at least as long as the commodity holds together.

⁶ *The Poster*, December, 1925, p. 16.

When such cultivated desires are interfered with, resentment and anger are likely to result. Deprive a dog of his bone when he is hungry, hold an infant's arms when it wants to move, and in either case angry responses will follow and will continue until the purpose can be carried out. Pedestrians often feel resentment when others impede their progress along the street, if only for a moment. Adult life is full of such resentments which are seldom clearly identified with or attributed to their proper causes. Moreover, these feelings of dissatisfaction and resentment accumulate and color the whole life of the individual for the time, and may in some cases last surprisingly long.

This condition of unsatisfied desire and its consequences have been strikingly painted recently by a novelist⁷ from whom the following passage is quoted:

The story is that in a pub near by . . . I got talking to one of the employees, a middle-aged chap and a sulky, taciturn sort of devil. However, we got putting it across and he opened up. I had started on racing. He hopped straight out of that on to politics, socialism, capitalism, class war and all that; and he put up a lot of bitter stuff . . . about the miserable conditions of the Workers as opposed to the luxurious lives of the Spenders; that was his division of Society, Workers and Spenders. I said to him, "Well anyway you . . . people haven't got much to complain about. You are done under model conditions that twenty years ago would have been thought heaven and that crowds of other workers would think heaven today! . . ." "Model conditions!" he said, "perfect ventilation, warmth, light, wash-houses with running hot water, canteen, first-aid departments, recreation rooms, all the rest of it. What in hell do you think they give us model conditions like that for? . . . all that stuff, all those model conditions, is just to get more out of us."

It is not when they are at their desks that the Palefaces are judged by the Redskins, and it is not when he is in his surplice

⁷A. S. M. Hutchinson, *One Increasing Purpose* (Little Brown and Co., Boston, 1925).

that a clergyman is judged of his people, and not when he is lecturing him that a father is judged by his son, and not when one out of a million stops and does the Good Samaritan that the world is judged by a fallen. . . . It is when they are out about their common ways that people are judged. That man whom I talked to in the public house . . . divided us up into the Workers and Spenders; and he gave me, bitter as acid, all this class feeling that there is about; what else could he give me, a man who makes a division like that? But can't I see the reason of it! The reason of it just is that the Workers do not judge the Spenders as they see them at their desks, they judge them as they see them outside, gone off and taken their hearts with them to where their hearts really beat—where the luxury, and the pleasure and the waste and the leisure is; floating about in cars and the Workers splashed by the mud; in restaurants and as much gone in a nod to the waiter as the Workers can earn in a week; in warm and lovely houses, in padded clubs, and all that, and the Workers outside where the rain and wind is. That is where the Workers judge the Spenders and that is whence comes the hatred, the creation of Haves and Have-nots.

POWER AND DESIRE

Why should there be this serious disparity between classes whose fundamental wants are similar if not identical? Because satisfaction of these wants depends upon *power* rather than upon mere presence of the wants or desires. Similarity in wants, difference in power, lead to anger and resentment. Power for accomplishment, let us call it intelligence, although it is probably much more than that, is a natural endowment just as our fundamental wants are, but it is not uniformly distributed as our wants seem to be. There can be scarcely any doubt to-day that this is so. The following, quoted from John Dewey,^{*} a severe critic of modern intelligence measurement, recognizes such differences in power:

The most ardent of the early advocates of equality never fell into the stupidity of alleging that all persons are quan-

^{*}J. Dewey, "Individuality, Equality and Superiority," *The New Republic*, December 13, 1922.

titatively alike. Rousseau was one of the first to insist upon natural differences, psychological and physical. It was his profound conviction of the intensity and scope of these differences which made him so insistent upon political, legal and, within certain limits, economic equality. Otherwise, some form of native superior energy would result in the enslavement of the masses, adding artificial enfeeblement to their natural deficiencies, while corrupting those of superior ability by giving them an artificial mastery of others and a cruel contemptuous disregard for their welfare.

It would seem that raising the general level of living will not solve the present difficulty, for the disparity between the Spenders and the Workers or the Palefaces and the Redskins, as the novelist above quoted calls them, will still remain. *Satisfaction is a relative and not an absolute quantity.* One's bread and cheese will turn sour in the mouth at the sight of another's cake and champagne. As the general level of living shifts, the purposes and ambitions shift along with it, while power cannot thus shift. Indeed, it would appear that the higher the level of living rises the greater will be the unrest, for the greater will be the disparity between the Haves and the Have-nots (in terms of intellectual power) unless increasing disparity is inhibited through artificial means. There scarcely seems to be the increase in satisfaction of the worker which might have been expected from the elevation of the standard of living during the last fifty to seventy-five years.

The whole problem thus far discussed depends on the fact that our conception of human values rests upon power and not upon motives and purposes, upon ability rather than upon intentions. Hence the greater importance to be attached to differences in the former than to likenesses in the latter. Moreover, power is interpreted to mean economic power, that is, power which is manifested in the production of what is economically valuable. The executive head of an organization is of more value than one of its ordinary laborers, because he produces more, therefore he gets a greater return

for his services. His standard of living is correspondingly higher. A notion of the discrepancy in value, thus measured, may be gained from the fact that a company may insure the life of its head for a million or two million dollars, but takes out no life insurance on its laborers. And yet, if values were calculated on the basis of motives and purposes, instead of capacity to produce, these individuals might be equal.

It seems, from the foregoing analysis of the fundamental human factors in industrial problems, that the recognition, on the part of any one or all the parties concerned, of common purposes will not bring the degree of coöperation that we might wish. For there will still remain the disparity of economic power (depending among other factors on intellectual power) with the consequent disparity in value and return for services. Can or should the standard of values be shifted from its economic to a purpose basis, so that all whose intentions are noble and who prosecute them to the best of their capacity will be equal in value and be equally rewarded? This is a problem for the social philosopher rather than for the psychologist. Such a proposal is implied in the idea of "moral values" according to which every one shall be rewarded according to the degree to which he fulfills his mission in life, whatever that mission may be. He who has ten talents and makes the most of them, shall receive no more than he who has one talent and makes the most of that. To quote again from Dewey:

Our new feudalism of the industrial life which ranks from the great financier through the captains of industry down to the unskilled laborer, revives and reënforces the feudal disposition to ignore individual capacity displayed in free or individual pursuits. Sometimes in theory we conceive of every form of useful activity as on a level with every other as long as it really marks the performance of needed service. In these moments we also recognize in idea at least that there are an infinite number of forms of significant action. But these

ideas are usually restricted to religiously accented moments. When it comes to practical matters, the very person who in his religious moods asserts the uniqueness of individuality and of opportunity for service falls back upon a restricted number of conventionally formulated and esteemed occupations and is content to grade persons in a quantitative comparative scale.

This chapter has shown that the satisfaction of the worker is a highly complicated matter and that dissatisfaction is not to be cured by a single remedy applied either to the working or non-working conditions. Our feelings are products of all our activities regardless of their sources, and they diffuse into a total state called satisfaction or dissatisfaction. The origin of the components of this state is difficult and sometimes impossible to trace. The greatest and most immediate benefit will come from the proper selection of individuals for their work according to their intelligence and character fitness, and from their proper adjustment to their working conditions, so as to remove the obvious causes of irritation, to safeguard their health and life. The dissatisfaction arising from the unequal distribution of the world's satisfiers presents a more serious problem for which no practical remedy has yet been offered. The greatest hope of a remedy lies in the thorough understanding of human nature, the manner in which and degree to which it may be safely modified through the forces of education and social pressure. Such an understanding should pave the way for a readjustment of the work and the worker to each other so that he shall get satisfaction in return for a full exercise of his capacities.

CHAPTER XXI

BUSINESS PSYCHOLOGY: I. THE NATURE OF THE CONSUMER

THE distribution or marketing of goods remains for consideration under the head of Business Psychology according to the plan outlined at the beginning of Chapter XVIII. The adoption of the psychological attitude toward the problems of marketing produces changes as profound as those which resulted from its introduction into industry, where the process of adjusting the work to the individual is still in progress. A casual survey of the hundreds of the older books and articles on the problem of the distribution of merchandise, as far as it concerns contact with the consumer, reveals an interesting point of view. The process of transferring goods to the consumer was conceived as a kind of combat in which all plans must be laid so as to guarantee that the distributor shall win and the consumer shall succumb. The terms used clearly indicate that this is the attitude in which the consumer was usually approached. There was talk of the "strategy" and the "tactics" of salesmanship, of the "sales attack," of the "shotgun method" and the "rifle method" of selling, of the technique of "breaking down resistance" and of "consumer defenses," etc. Goods were manufactured and *had* to be disposed of. Somebody must be made to buy them.

In striking contrast to this militaristic point of view is the modern conception of the consumer as an entity with certain wants and desires, of the distribution of goods to the consumer as a rendering of service to him, as a means of

providing him with what he wants and of giving him satisfaction. This is not a mere change of terminology but represents a radical shift of attitude toward the whole problem of marketing. To be sure, in practice there may be a mere superficial shift in terminology without a shift of technique. Such is the state of affairs in most of the current usage of the term "service." On the other hand, the actual attitude of service may be made the keynote of the marketing program, while the older combative terminology is retained. A careful examination is required to determine the true nature of any particular conception underlying methods of distribution.

The genuine conception of the problem of distribution as one of service implies a knowledge of what people really need and want and a knowledge of the means of satisfying these needs and wants. It is the particular function of psychology to build up such a knowledge of human nature as this conception requires. The everyday association of one individual with another is not at all likely to furnish this basic information, for human motives and desires are often disguised, and even to oneself they seldom appear in their true form. This is demonstrated in the reasons that persons give for their actions. It frequently happens, therefore, that, where the ideal of service is behind a selling plan, failure will occur because there may be an inadequate or distorted knowledge of human nature. A keen appreciation of the problems of distribution in terms of human nature has led the inquirer to seek the aid of observers trained in the psychological laboratory.¹

¹ The psychological approach to the problems of distribution is presented in the following: A. J. Snow, *Psychology in Business Relations* (A. W. Shaw Co., Chicago, 1925); E. K. Strong, *Psychology of Selling and Advertising* (McGraw-Hill Book Co., New York, 1925); A. T. Poffenberger, *Psychology in Advertising* (A. W. Shaw Co., Chicago, 1925); H. D. Kitson, *The Mind of the Buyer* (The Macmillan Co., New York, 1921).

PURCHASING POWER OF THE CONSUMER

The marketing of goods requires a knowledge of all the characteristics of human behavior and the way in which these characteristics are distributed within the population as well as the conditions upon which the expression of these characteristics depends. Such a program involves the whole content of psychology and economics, although certain parts of these fields have a more direct application than others. The facts of psychology that are most important are those that concern the "desire to purchase" while the facts of economics that are most important are those that concern the "power to purchase." These two kinds of data are so inter-related that it is impossible to treat the one without the other. In some cases, the desire to possess will be restricted by the power to purchase; in some the power may be expanded to meet the desire; while in others the desire may far exceed the power. The ideal in marketing would be to stir up the desires that are within the power of the individual to satisfy. But modern advertising, through the widespread publicity which it creates, frequently arouses desires within the minds of its readers that are not within their power to satisfy. The consequences of too great a discrepancy between desires and the power to satisfy them was discussed on page 404. It may be responsible in part for many of the evils in business and industry to-day. Finally, it must be recognized that there may be the power to purchase without the desire, as in the case of many persons who have an exaggerated desire to save and accumulate capital, and also in the case of portions of the population for certain classes of commodities.

The power which has been referred to may be thought of as economic power or income, and as mental power or intellect. Although these two kinds of power are not perfectly related as cause and effect, it will be satisfactory for our

purpose to consider merely economic power and its bearing upon the distribution of goods. The distribution of power as represented by the distribution of incomes within the population is difficult to determine, but estimates have been made for the year 1918 which are considered reliable and which for our purpose may be accepted as typical.² In that year there were in the United States approximately

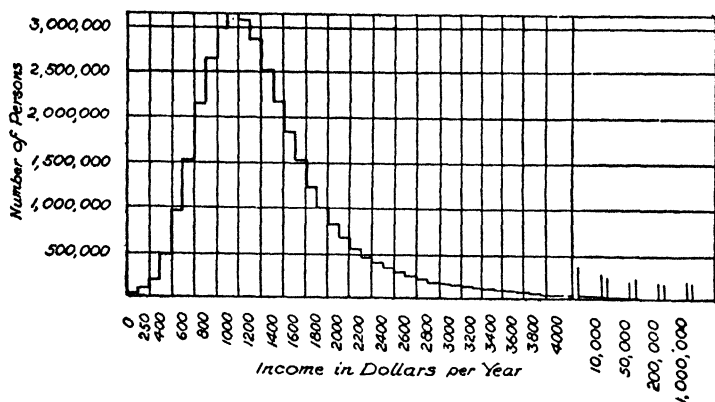


FIG. 41. DISTRIBUTION OF INCOME IN THE UNITED STATES

40,000,000 people receiving income, distributed as indicated in Figure 41. The horizontal scale gives income in steps of \$200 up to \$4,000, where the curve is broken. From that point, the steps represent extremely large amounts. The vertical scale is in terms of number of persons. Certain facts may be more readily noted from Table XXXVI, where the figures in the first column indicate amounts of income, those in the second column show the per cent of the income-receiving population that gets that amount or less, and those in the third column show the per cent receiving just that amount.

² Adapted from National Bureau of Economic Research, *Income in the United States*, Vol. I, p. 128 (Harcourt, Brace and Company, New York, 1921).

TABLE XXXVI. PURCHASING POWER OF THE POPULATION OF THE UNITED STATES

Income	Per Cent of Persons Receiving Given Income or Less	Given Income
\$ 400	2.84	1.30
600	9.52	4.12
800	22.35	7.10
1,000	38.75	8.37
1,200	54.51	7.59
1,400	67.13	5.87
1,600	76.04	4.03
1,800	81.99	2.66
2,000	85.92	1.77
2,500	91.35	0.69
3,000	94.08	0.41
4,000	96.61	0.16
6,000	98.38	0.62
8,000	99.01	0.25
10,000	99.32	0.13
25,000	99.83	0.07
100,000	99.98	0.004

The average income for that year was \$1,543 when the incomes of soldiers and sailors were excluded and \$1,490 when they were included. A glance at Figure 41 shows that the average is much influenced by the long tail of the curve representing incomes that run up into millions of dollars. The median income, which is that of the middle person when all are arranged in order of size of income from smallest to largest, seems a more satisfactory measure because it is not affected by the extremely large incomes. The median income for the 40,000,000 people was only \$1,140. That means that half of the whole money-earning population received that much money or less per year. The lower quartile, that is, the income of the person 25 per cent of the distance from the

lowest to the highest, was only \$933, which means that 25 per cent of the population received only that much money or less per year. Still more enlightening is the upper quartile, or the income of the person who stands 75 per cent of the distance from the lowest to the highest. It is \$1,574, which means that 75 per cent of the income-earning population received that much or less per year.

The satisfaction of desire for widely advertised and distributed commodities is definitely limited by income. The reader may satisfy himself as to the degree of such limitation by checking these incomes against the advertised prices of automobiles, radios, furniture, travel, books, etc. Further light will be thrown on the limitation of desire by a survey of how the typical income was spent in 1918. The expenditures of the average family income of \$1,513.19 (in the particular group studied) were as shown in Table XXXVII.⁸ These figures represent what is probably the irreducible minimum for such basic needs as food, shelter and clothing (including fuel and light). There is left, after the deduction of these items, \$459.67 for all other expenditures. Such economic facts as these cannot be ignored in the consideration of the nature of the consumer and what he needs and wants. For example, can the median individual afford to purchase and own an automobile, and if so, how much can he afford to pay for it, assuming that he buys it on the installment plan and needs a new one every five years? The same question may be asked about many other commodities for which current methods of distribution stimulate a widespread desire.

As stated above, these economic facts cannot be correctly interpreted when isolated from the psychological characteristics of the consumer. For there are inseparately bound up

⁸ Adapted from W. A. Berridge, E. A. Winslow, and P. A. Flinn, *Purchasing Power of the Consumer* (A. W. Shaw Co., 1925), p. 130.

TABLE XXXVII. EXPENDITURES OF A TYPICAL FAMILY IN 1918

Rent	\$191.37
Food	548.50
Clothing	237.60
Fuel and light	76.15
Taxes and insurance	45.45
Furniture and furnishings	73.22
Charity and religion	11.47
Dues, etc.	8.09
Recreation	18.90
Books and newspapers	17.82
Tobacco and liquor	23.74
Sickness and other emergencies	62.63
Miscellaneous	119.42
Surplus	78.93
TOTAL	\$1,513.29

with the power to purchase, such fundamental traits as the tendency to save or not to save money, to maintain a certain apparent standard of living at a sacrifice of other essential items of living, to pay only certain prices for given commodities, to buy certain things at specified places, to buy in particular amounts or in particular forms, to continue to use the same kind of article as used before, or to want something new and different. Some of these traits are fairly stable throughout a whole population, some of them are common to large classes of people, or to large geographical areas, while some are peculiar to individuals. With this simple statement of the need for knowledge of the economic individual in its bearing upon the problems of marketing, primary consideration will be given to the psychological characteristics of the consumer and his needs.

THE DESIRES OF THE CONSUMER

All human beings have needs, wants and desires which demand satisfaction. Some of these are bodily needs and

comprise the essentials for maintaining life, such as the need for nourishment and for protection from danger. They are almost certainly inborn. It is not difficult to understand why these demands should exert such a powerful influence over behavior as they do. Other wants which manifest themselves primarily in the relationships among individuals are probably inborn also. Chief among these is the need for self-expression. These so-called social needs are given a variety of names and are variously classified by different authorities. Their influence in determining behavior cannot be questioned, although the reasons for it are not so self-evident as in the case of the bodily needs.

In their original form, these needs manifest themselves in vague reactions and general restlessness. In fact, it seems that the means of satisfying them are not definitely specified by nature, but are the result of a process of education which the individual undergoes from his earliest years. The few original needs are expanded, subdivided and specialized, and the means of satisfying them are multiplied and diversified until they bear little resemblance to their sources. Thus the need of the body for fluids may in the adult appear as a desire for a glass of water upon arising in the morning, a cup of coffee for breakfast, coca-cola in the middle of the morning, buttermilk at lunch, tea in the afternoon, a cocktail before dinner, and soda after the theater at night. To be deprived of any one of these, or the substitution of one for the other, will frequently cause annoyance. Likewise, the social needs come to be satisfied in a very diverse manner by different people and at different times. The so-called tendency toward self-assertion may appear in the struggle for a position in the realm of science, athletics, business, industry, or fashion. In each of these, it may take many specific forms, which are too obvious to need cataloguing.

One of the most significant and powerful of the present-

day forces in this educational process is advertising broadly defined. Whenever the public can be educated into the acceptance of a given commodity as the best means of satisfying one of its needs, its success as a marketing proposition is assured. The keen observer of marketing methods will have discovered a number of articles of commerce that have jumped into great prominence as household necessities, not through the slightest change in the article itself, but merely because it has been demonstrated as a satisfier of a real want. The recognition of these facts has brought about a revolution in marketing methods. Thus, Listerine is offered, not as a mouth-wash or a disinfectant, but rather as an aid to success in the world of business and society; Pepsodent and Palmolive soap bring love and happiness and not merely cleanliness to their users; correspondence courses no longer merely educate but prepare one to become a bank president or other high executive; American furnaces and radiators do not merely heat the home but fill it with an atmosphere of hospitality. Many other illustrations might be given to show how goods may be represented as satisfiers. Not all are successful, for it requires a high degree of skill and ingenuity to show how a new product will satisfy an old need in an entirely unexpected and unusual way. Success, however, carries with it a large reward.

As these needs have been considered in Chapter II only one or two of them will be mentioned for purposes of illustration.⁴ One of the most consistently exploited of them is the desire to conform, or to be like others. The desire of every one to have what his neighbor has, is recognized as one of the most powerful aids in the expansion of markets. Advertising is one of the many publicity devices that make all men neighbors and enlarge their de-

⁴ A detailed discussion of desire and its bearing upon advertising methods will be found in A. T. Poffenberger, *Psychology in Advertising* (A. W. Shaw Co., Chicago, 1925), Chaps. 2, 3 and 4.

mands accordingly, and it is one of the most effective of them. Motion pictures, the radio, newspapers, magazines and automobiles are unintentional allies of advertising in this process of expansion of acquaintanceship of all classes and all peoples.

Closely related to this desire to conform is another that is susceptible of satisfaction in the greatest variety of ways, and that has been effectively played upon for the purpose of marketing new commodities. It is called ambition, and leads one to do a little better than his neighbor, and just as well as those that are above him. This trait, and the extent to which it determines the course of life, is beautifully portrayed in *The Competitor*, by Galsworthy. Almost any magazine or newspaper will yield specimens of advertising that profit by the strength of this distinctly human need. The following paragraphs are extracted from a full-page advertisement that appeared in one of the best-known of American newspapers:

The reason most people fall miserably below what they dream of attaining in life is that certain mental faculties in them become absolutely atrophied through disuse, just as a muscle often does.

Be honest with yourself. You know in your heart that you have failed, failed miserably, to attain what you have once dreamed of.

Was that fine ambition unattainable? Or was there just something wrong with you? Analyze yourself, and you will see that at bottom there was a weakness somewhere in you. What was the matter with you?

Find out by means of Pelmanism; then develop the particular mental faculty that you lack. You can develop it easily; Pelmanism will show you just how; 550,000 Pelmanists, many of whom were held back by your very problem, will tell you that this is true.

If you are made of the stuff that isn't content to remain a slave—if you have taken your last whipping from life—if you have a spark of independence left in your soul, write for this

free book. It tells you what Pelmanism is, what it has done for others, and what it can do for you.⁸

As ambition is universally present in some one or more of its many forms, and as it is practically never entirely satisfied, the words just quoted constitute a powerful spur to action. When a desire for some object or end has been excited by advertising or any other means then the consummation of it brings satisfaction. On the other hand, the thwarting of the desire brings dissatisfaction. It is in this sense of fulfilling people's needs, and thus giving them satisfaction whether by means new or old, novel or commonplace, that marketing constitutes service.

THE HABITS OF THE CONSUMER

The fact that the means of satisfying desires are largely the product of education offers an unlimited field for the development of markets for new commodities and new markets for old commodities, but at the same time it introduces obstacles in the way of such development by the fixity of habits after they have been established. The promoter of one commodity counts on the fixity of habit for maintaining a market for his goods, while his competitor counts on the force of education to turn the consumer to his product. The resistance that a new product has to meet is seldom sufficiently understood. No matter how convenient, economical, healthful or pleasing it may be, it will meet a strong tendency to continue the use of the more familiar article. The purchaser may even make a resolution that, when the need next arises, the new commodity will be purchased, but habits of mind as well as of action will frequently make the resolution ineffective. The years of publicity and education that were required to bring about

a general use of the safety razor defy explanation except in terms of deeply rooted habits. The resistance offered to the adoption of substitutes for shaving soap, of paper dishes, of fireless cookers, and hundreds of other labor- and money-saving devices for home, office and factory must be accounted for in the same way. Habits determine not merely what article shall be bought, but where it shall be bought, how much shall be paid for it, how much shall be bought at a time, whether in package form or loose, etc. To be asked to pay \$2.50 for a watch that one is accustomed to think of as a dollar watch, or \$7 for shoes that have been bought for \$4, will meet resistance, no matter how legitimate the increase may be in terms of the decrease in value of the dollar. Likewise, to be offered an oriental rug for \$25 when one has been accustomed to think of them as expensive luxuries will arouse opposition and perhaps suspicion. In fact, any changes in response to old situations will be made with a degree of difficulty which depends upon the fixity of the attitude toward them.

Habits peculiar to individuals, naturally, cannot be taken into account in general advertising, but there are many habits that are common to masses of people, to social classes, to geographical districts and to occupational groups. These should be discovered and allowed for. The salesman will do well to know as much as possible about the habits of his customers, both in order to satisfy them and to reconstruct them when necessary. It is just as necessary for the advertiser to know group habits in order that he may deal with them intelligently in his printed message.

Finally, it should be remembered by both the advertiser and the salesman that to perform habits in an unimpeded fashion gives satisfaction, and to be interfered with in their performance causes dissatisfaction just as surely as furthering and hindering the more natural tendencies to action cause satisfaction and dissatisfaction.

THE LOGIC OF THE CONSUMER

Do the needs arising from natural tendencies and from habits constitute the sole source of the buying motive? It is commonly supposed that reasoning or cool calculation plays a large part in determining these reactions, that decisions are made after a process of deliberation. Since the analysis of human behavior shows that actions based on logic are rare indeed, we should not expect to find them playing a very prominent rôle in buying. In fact, where one seems to be reasoning out his actions he is seldom really doing so. Any perfectly honest observer of his own behavior can discover this fact for himself. His everyday purchases certainly are the result of habits or needs which are never put to any logical test. But even the more unusual investments and those which involve a considerable expenditure are very frequently "impulsive." One wants a certain type of automobile or radio very much. It is costly and far more elaborate than necessary for the use that it will receive. Another cheaper one will do quite as well. Arguments can be found, however, to support the desire, and the expensive one will be bought. Such reactions, much as they seem like reasoned ones, are not strictly so. The decision is not made after a process of deliberation. It is made first and is based directly on desire. Deliberation then furnishes support for the action already determined. This artificial type of reasoning is widespread and can be found at work in every level of intelligence. It is known as rationalization. (See Chapter V.) There are cases, of course, where reasoning plays a part, and these are to be found especially in the purchase of tools, instruments and equipment generally, where the economic factor predominates, and where the logic is largely one of dollars and cents. It is one of the achievements of the marketing expert that he can inject into such strictly colorless and prosaic objects as a heating plant

much of the personal and social quality that attaches to the more intimate things of life, and thus transfer this purchase from the realm of logic to that of unreasoned desire.

RELATIVE STRENGTH OF DESIRES

This brief examination of the consumer, his needs and the motives that impel him to buy, shows that any article of commerce may be made to satisfy one or more of a variety of desires. A survey of soap advertising a few years ago disclosed the fact that different brands were presuming to satisfy seventeen different basic desires, such as desire for cleanliness, health, comfort, beauty, youth, social prestige, love, etc. Other products have been found to make an equally variegated offering. In fact the range of appeals that may be employed in marketing a product is limited only by the ingenuity of its promoter. Naturally, some appeals are more effective than others. To determine which is the best appeal to use for a given purpose is almost as complicated as solving a difficult mathematical equation, because of the number of variables involved. First, there is the question of the relative strength of the different appeals, or rather the relative motive force of the needs aroused by the appeals. This is difficult to determine in human beings, as suitable objective methods have not yet been devised.⁶ It is not safe to make more than very tentative generalizations from the objective studies of the strength of impulses in animals, where the largest amount of work has been done on this subject. The method which has been relied on is that of subjective report. Persons are asked to state, with the help of one of the rating methods such as were described in Chapter XV, what is the relative potency

⁶The method recently described by Nixon offers some possibility of objective measurement of desires and interests. See H. K. Nixon, "Attention and Interest in Advertising," *Archives of Psychology*, No. 72 (1924).

of the various desires in guiding their actions. Such judgments are not impossible to make and yield some interesting results which check favorably against marketing returns. For instance, the desire for food, for protection, and the love of offspring always stand high. Next to these come the social tendencies, such as sociability, imitation, hospitality, etc., and finally, the appeals that do not tap any real personal interests, such as guarantee, reputation of the firm, danger of substitutes, etc.

Second, in addition to the strength of the impulse aroused by the abstract appeal, its appropriateness for the particular commodity must be discovered. Some appeals are obviously poorly suited to certain products while others are just as obviously well suited. For instance, where economy might be an important point in regard to laundry soap, it is of practically no consequence whatever in connection with perfumes. Health-giving qualities, together with cleanliness, however, have attained a high standing in all the tests of the strength of appeals that have been published and underlie the successful marketing of a wide range of commodities.

Third, an appeal will not be successful if it has been used frequently before for the same purpose, even if it happens to be, in general, a very powerful one. Uniqueness and distinctiveness are essential factors that must be added to strength in every successful appeal.

When the appeal has been chosen to satisfy the conditions just outlined, it must be put into words and pictures. Here, too, a good appeal may be ruined and a poor one much improved by the way in which it is presented. On account of these variables, it is expedient not to rely too much upon the theoretical expectation of strength in the appeal, but to test its strength upon a sampling of consumers. This may be done by the test campaign familiar in advertising procedure, or sometimes more simply by the application of the order of merit method to determine the relative strength of

a series of proposed appeals. No method of testing, however, can replace a thorough understanding of the mechanism of human behavior and the complex of the motives that drive it.

CHAPTER XXII

BUSINESS PSYCHOLOGY: II. THE ADJUSTMENT OF ADVERTISING AND SELLING METHODS TO THE CONSUMER

IF the marketing problem from the psychological point of view is conceived as a problem of service to the consumer, and if service means giving the consumer what he wants, how may this service be most readily and effectively rendered? To know what the consumer wants is the first essential, but the manner of telling him what will satisfy his wants, and especially of convincing him that a particular commodity will satisfy his wants best, is almost as important. In order to present this message most forcibly, one must know all the conditions upon which a complete grasp of it depends, and all the factors that will further a favorable reaction to it. First, it will be necessary to make a distinction between the two methods of delivering the message to the consumer, namely, advertising and direct selling. They differ in that the former is a project directed at large masses of people, while the latter is directed at the individual, and in that the former makes only an indirect contact with people through the medium of a printed message while the latter makes direct contact of buyer with seller. In advertising, the modification of the tactics of selling to suit the individual prospect so as to influence his conduct most readily is out of the question, hence the necessity for finding universal appeals to the human wants is obvious. Direct selling has been slower than advertising to lay aside the attitude of combat, because in selling there is an opportunity to adjust attack to meet shifting resistance.

As a consequence of these differences between the two marketing methods, advertising must play upon the human needs that are common to large groups and must avoid appeals that would be effective only for particular persons or small groups. Salesmanship, on the other hand, needs to know not only the traits that are universally present, but it needs to know as much as possible about how one individual differs from another, and as much as possible about the particular individual prospect. If illustration of this difference be needed, it will be furnished by comparison of the advertisement in Figure 42 with the data reproduced below, which were used in selling an insurance prospect. The advertisement shows the need of protection "no matter who you are, where you live, what you do, whether man or woman." It counts on the presence of family affection and the uncertainties of life to be universally present and makes a general appeal on the basis of these two facts. In strong contrast to this is the list of intimate details¹ of the life of the prospect upon which an insurance-selling plan was based.

Carter C. Barnes, dentist, Middletown, Conn.

Age, 36 in 1919, born, May 25, 1883.

Has \$3000 twenty-premium life in this company, taken out at age of 30. No other insurance known.

Married—has three young children, a boy and two girls.

Now practices alone, but until recently was associated with an elder dentist, Dr. Warden.

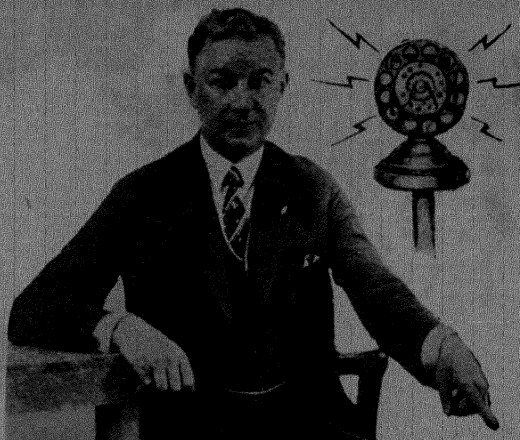
Income unknown; probably about \$3500 or \$4000.

Graduate of local college, Wesleyan University, takes an active interest in college affairs and in his fraternity, Psi Upsilon. Is a member of the Methodist Church, the Country Club, and the University Club.

Wife has inherited \$35,000 from an uncle, according to the papers.

¹ E. K. Strong, *Psychology of Selling and Advertising* (McGraw-Hill Co., New York, 1925), p. 208.

"This is Schaffer *The Insurance Man Speaking to You!"*



Broadcasting from Coast to Coast **"You may be next"** (You never can tell) **To Every Reader—Attention!!**

INSTEAD OF knocking at your door—I address you through the public press.

I am your best friend in time of need. I AM THE INSURANCE MAN. And what I have to offer, you really need. Daily the newspapers report casualties of every sort. Then, why gamble with life's uncertainties when so much is at stake. Insurance is indeed "an ounce of prevention" rather than a "pound of cure." Not only as a financial safeguard; it is economical as well. The policy that I am offering you will not prevent an accident nor stave off sickness, but will help pay all bills incidental to same, and a substantial amount for a fatality. **SAFETY FIRST! YES, BUT INCLUDE PREPAREDNESS, TOO.** The saddest cases of all are those who fail to protect themselves with Insurance. I firmly believe it is every responsible man's and woman's duty to be protected by Insurance. The protection of Insurance is the best way to soften the brutal shock of unforeseen disaster.

For years I have hammered away in the columns of this paper the importance and necessity of **INSURANCE PROTECTION**. Thousands have heeded my advice, but thousands upon thousands of persons have as yet failed to obtain one of these policies, and this message of mine is directed to them. No matter who you are—Where you live—What you do—Whether man or woman—**YOU NEED** this protection, and you should obtain it at once. **THINK OF YOURSELF—YOUR LOVED ONES—YOUR CHILDREN—WIFE—MOTHER—FATHER—HUSBAND—BROTHER—SISTER.** Have you provided for their future? What would happen? **THINK IT OVER.** I am not an alarmist, by any means—far from it—only attempting to drive home true facts. In calling your attention, reader, to this matter, you will thank me. If you have as yet failed to learn particulars of this wonderful policy, do so **TODAY**—not tomorrow—but **TODAY**. Don't let today's opportunities be tomorrow's regret.

C. H. Schaffer

FIG. 42. PERSONAL APPEAL IN AN ADVERTISEMENT

WHAT CAN THE CONSUMER COMPREHEND?

In presenting the marketing message it is vital to know what the consumer can comprehend, and to prepare it accordingly. Any casual estimate of comprehension is very likely to go astray, because every one is inclined to think of other persons as being more or less like himself. In writing an advertising message for a large section of the population, there is great likelihood of overrating the comprehension of its readers. In fact it was difficult, if not impossible, to realize what the bulk of the population could be counted on to grasp in the way of a printed message, until the intelligence survey was made during the war. Not only was the percentage of illiteracy surprisingly large, but the percentage of people who could read only with difficulty was very much larger. The distribution of the ability to comprehend printed symbols, therefore, takes on considerable importance in the case of the advertising of widely used commodities, such as foodstuffs, soaps, etc. Some idea of the way in which this ability is distributed may be obtained from an examination of the distribution of intelligence as measured by the Army Alpha Intelligence Examination, if the score is expressed not in terms of arbitrary units, but in terms of chronological age. For instance, it can then be said that a given percentage of the population can understand printed symbols as well as the child of 10 or 11 or 12 years of age. Such data are given in Table XXXVIII. In the first column of the table are the customary letter grades indicating the various levels of intelligence. In the second column are the figures showing the per cent of the population falling within that grade; and in the third column the grades are expressed in terms of the average age of persons in whom this degree of comprehension can be found. Since our interest is in the ability to comprehend printed symbols, our conclusions will be free from the criti-

cisms that are frequently directed at intelligence measures. The average individual in the population of the United States will have, then, a comprehension equal to that of a 13 to 15-year-old child, while the lowest 25 per cent of the population will approximate the 10-year-old child in comprehension. If one wishes therefore to broadcast a message that would reach 75 per cent of the population, he would write as to a child of ten years. In the army it was found inadvisable to expect the lowest 25 per cent of the recruits to read and understand printed instructions.

TABLE XXXVIII. DISTRIBUTION OF INTELLIGENCE

Intelligence Grade	Per Cent of Cases	Equivalent Age
A	3.5	18 to 19.5 years
B	7.5	16.5 to 18 "
C+	13.5	15 to 16.5 "
C	21.5	13 to 15 "
C-	22.0	11 to 13 "
D	22.0	9.5 to 11 "
D-, E	10.0	0 to 9.5 "

The average vocabulary of persons of different ages has been calculated as follows:

Superior adult	13,500 words
Average adult	11,000 "
12 years	7,200 "
10 years	5,400 "
8 years	3,600 "

These are probably very generous estimates. It is safe to assume in the light of these figures that, when a superior adult writes for the comprehension of as much as 75 per cent of the population, he must limit his vocabulary to less than half its customary range.

When actual experimental tests² are conducted to find out how well written advertisements are adjusted to their readers, many avoidable discrepancies are found between the character of the message and the degree of comprehension of the readers addressed. Not only are many words used that are not comprehended, but sentence structure is often too complicated and the ideas contained in them are too complex to be readily grasped. The current tendency to use highly technical and scientific terms in advertising is not justified by a knowledge of the distribution of the ability to comprehend them. Kitson³ has proposed to determine how advertisements should be written by studying the character of the other printed matter in the medium carrying the advertising. His assumption is undoubtedly sound that the news story content of a magazine or newspaper must be adjusted to the comprehension of the reader or it will fail. Advertising to appear in the same medium should be prepared for the same level of comprehension. Using word length and sentence length as indicators of the character of the material, he compared various media and found interesting differences in both these respects. For instance, one magazine had 59 per cent more three-syllable words than another, and 33 per cent more sentences containing twenty or more words than another. Also a certain newspaper had 70 per cent more three-syllable words and 13 per cent more sentences of more than twenty words than another. Such data represent interesting adjustments to the comprehension of readers and should be reflected in the advertisements.

In the light of the small amount of data that are available, it is wise to err on the safe side and "write down" to the

²A. T. Poffenberger and D. Goldstein, "The Comprehension of Advertisements," *Journal of Applied Psychology*, Vol. VII (1923), pp. 364 f.

³H. D. Kitson, *The Mind of the Buyer* (The Macmillan Co., New York, 1921), pp. 54 f.

advertising audience. A lesson may be learned also, from the universal appeal of motion pictures and the picture newspapers, that a story can be told in pictures with a minimum of word symbols when it is necessary to do so. Whenever an extremely wide distribution of the population is to be reached a generous use of pictures is advisable, as on billboards, for even illiterates can be reached through the message of the picture. One can buy Camel cigarettes, Barking Dog tobacco, special brands of crackers, soaps and many other commodities without being able to comprehend printed symbols.

WHAT CAN THE CONSUMER DISCRIMINATE?

The discrimination of the consumer enters into the buying reaction in a multitude of ways. As to the commodity itself, what differences in its quality or quantity, pattern, texture or size are distinguishable in the everyday contact with it? Are there more sizes and grades of things that can be discriminated readily? It is quite evident that the development of a stock of goods based upon the easily noticeable and practicable differences would lead to a reduction in the variety of many lines of commodities. This is especially true in grades of textiles, papers, etc., the sizes of screws, nails and other hardware. On the other hand, the application of the facts of discrimination would lead to the adoption of finer gradations of quality and size in some cases. The introduction of quarter sizes in men's collars, for example, was a needed innovation and illustrates the value of taking the consumer into account in planning merchandise. There is scarcely any line of goods that would not profit from a survey of the capacity of the consumer to discriminate among its varieties.

The discrimination of the consumer enters into the marketing problem in quite another way. It is a commonplace of marketing technique that a newly introduced commodity

should be distinctive in name and container at least, so that it will not be confused with other similar products already on the market. Likewise, advertising characteristics of one article should not lead to confusion with those of another. And yet both of these errors occur, because the discrimination of the consumer is far overrated. Barring the cases where confusion is deliberate in order that one product may prosper through the prestige of another, such costly mistakes could be avoided by careful examination of the facts of discrimination. The most abundant data on this question are to be obtained from the trade-mark and trade-name litigation, where confusion has been so great as to damage the interests of one or the other commodity. Interest has been directed especially to finding some ready means of measuring confusion arising through the inability to discriminate between various trade-names or trade-marks, but it would be far more profitable to measure the possibility of confusion as a preventive instead of as a means of settling legal disputes. The efforts of Paynter⁴ to measure confusion empirically and to create a scale for the purpose, demonstrate the possibilities of psychological technique in solving such problems. He was able to show that legal decisions do not necessarily conform to objectively measured confusion, as indicated in Table XXXIX. The per cent of confusion means the per cent of people who confused the imitation and the original from its appearance and sound. The meanings of the other columns are clear from their headings.

In the planning and construction of advertisements, what importance is to be attached to certain costly innovations in terms of the ability of the observer to perceive them? Who can distinguish between a certain type-face and another that is one-half point smaller, in his ordinary contact with it? Can the average reader of an advertisement distinguish

⁴R. H. Paynter, "A Psychological Study of Trade-Mark Infringement," *Archives of Psychology*, No. 42 (1920).

TABLE XXXIX. DISCRIMINATION AMONG TRADE-NAMES

Original	Imitation	Per Cent Confusion	Legal Decision
Sozodont	Kalodont	28	Non-infringement
Nox-all	Non-X-Ell	28	Infringement
Club	Chancellor Club	35	Infringement
Bestyette	Veribest	35	Non-infringement
Mother's	Grand-Ma's	38	Non-infringement
Au-to-do	Autola	40	Infringement
Peptenzyme	Pinozyme	43	Non-infringement
Green River	Green Ribbon	50	Infringement
Ceresota	Cressota	63	Infringement

between three-color, four-color and six-color printing? These different processes are too costly to be passed unnoticed. Are the more costly forms of art that are so prized by the advertiser distinguishable from the simpler and cheaper forms? These are all questions that the expert can answer for himself, but they cannot be answered at present for the three-fourths of the population that is to see them. Such questions, however, can be answered by carefully controlled psychological inquiry.

The problem of the size of advertising space to be used is reducible largely to the psychological question of discrimination. Large space is used mainly for getting and holding attention, and attention depends upon noticeable difference or distinctiveness. An advertisement will attract attention by size, not because it is big, but because it is *bigger* than its neighbors and competitors. This means simply that as far as attention is concerned, it is *relative* size and not absolute size in square inches that counts. A half page has a certain attention power whether it be half of a large page or half of a small page. The greater the relative difference in size, the more readily will the larger advertisement be discriminated and attract attention away from

its neighbors. How much larger one advertisement should be than another, and whether the distinctiveness thus attained is worth what it costs, are economic rather than psychological questions. Consideration should always be given to the possibility of getting the desired amount of distinctiveness in a more economical manner than by the use of large size. For there are many ways of attaining distinction, such as the use of color and color combinations, unique forms of illustration or typography, unique position on the page or in the advertising medium, unusual kind of copy, etc. It has been our purpose merely to point out the psychological character of the size problem and to suggest the wide range of questions that may be answered through the application of the facts of discrimination to the field of advertising.

WHAT ARE THE CONSUMER'S LIKES AND DISLIKES?

Modern psychology has recognized that the feelings form the vast undercurrent of life, influencing the course of behavior in manifold ways. It is a primary law of behavior that one continues doing, or repeats, those acts that are pleasant and inhibits or avoids doing those things that are unpleasant. For this reason the feelings have a very important relation to the processes of attention, interest and memory. In some instances the character of the feelings is surprisingly uniform for all people, as in the pleasantness and unpleasantness of certain tastes, odors and sounds. In other cases, the quality of the feelings aroused in a specific situation is peculiar to the individual and is the result of certain unique experiences. Such idiosyncrasies in the way of tastes, preferences, likes and dislikes will form valuable data for the salesman, since arousing pleasant rather than unpleasant reactions in any way whatever may mean successful service to the customer. Although such individual tastes cannot be appealed to in advertising, there are others that are sufficiently widespread to be counted on for this purpose.

Some of these are well known, such as the pleasantness of colors and color combinations, of lines and curves and of areas of specified proportions. In fact, the whole realm of æsthetics can be profitably searched for sources of pleasantness in advertising material. Experimental studies are often required, however, to find just what colors or color combinations, lines or type-faces will give the most pleasing effect for a specific purpose. The few studies that have been made show clearly that there are measurable differences in the effects produced by simple changes of proportion, line and color. For instance, experiment has demonstrated that, while the combination of yellow with blue, and of red with green are preferred by men and women alike, they are not the most preferred combinations for advertising particular commodities. Table XL gives the most preferred color combinations for ten different articles, in the opinion of one hundred persons. In some of these cases there is a rather wide variation in choice, while in others there is close agreement. Facts such as these can only be found out by experimental study.⁵

TABLE XL. COLOR PREFERENCES FOR SPECIFIC PURPOSES

<i>Article to be Advertised</i>	<i>Combination Most Preferred</i>
Building Material	Yellow and Orange
Jewelry	Yellow and Purple
Breakfast Food	Yellow and Orange
Perfume	Yellow and Purple
Coffee	Yellow and Orange
Schools	Yellow and Orange
Soap	Yellow and Green
Summer Camps	Yellow and Green
Candy	Red and Yellow
Summer Beverages	Yellow and Green

⁵ For details of this experiment and the technique employed, see A. T. Poffenberger, *Psychology in Advertising* (A. W. Shaw Co., Chicago, 1925), Chap. 17.

Results similar to this were obtained from a study of the appropriateness of type-faces⁶ for specific advertising purposes. Thus the form of script reproduced in Figure 43 was found to vary markedly in appropriateness for expressing five different abstract qualities, and for carrying the atmosphere of five different commodities. The numbers given underneath refer to the order of appropriateness of 29 specimens of type included in the study, hence the nearer the number is to "1" the more appropriate, and the nearer to "29" the less appropriate.

When in the Course of Human Events, it becomes necessary for one people to dissolve the political bands which have connected them with another, and to assume, among the powers of the earth, the separate and equal station to which §1234567890&

Cheapness	28	Automobiles	29
Dignity	5	Building Material	29
Economy	26	Coffee	29
Luxury	3	Jewelry	2
Strength	29	Perfume	1

FIG. 43. RELATIVE APPROPRIATENESS OF A TYPE FACE FOR DIFFERENT PURPOSES

The figures for this one type-face show that, while the script was the most appropriate of the whole 29 specimens for perfume, it was the least appropriate of them all for automobiles, building material and coffee. Any one who looks over a collection of current advertisements will see in them definite attempts to adjust type quality to the commodity advertised with much or little success. Here, as elsewhere, the judgments of individuals may be erroneous so that the

⁶ A. T. Poffenberger and R. B. Franken, "The Feeling Tone of Type-faces," *Journal of Applied Psychology*, Vol. VII (1923), pp. 312 f.

final test of appropriateness must be the favorable or unfavorable reaction of a sampling of consumers.

There is good reason to believe that many other aspects of advertising matter can be so chosen as to heighten the pleasant feeling-tone which it will arouse. This is especially true in the case of the choice of trade-names, slogans, etc. With the modern tendency to create new words as names for products, it would be a simple matter to regard the feelings that such words arouse. The writer has heard many comments upon the unpleasant feeling engendered by the word "spumoni" as a name for ice-cream. Such feelings attached to words are very complex in origin; sometimes they are due simply to their sounds, sometimes to the meaning of separate parts of the word, and sometimes to the connotation of the word itself. In this particular instance the sound of the name brought to mind two associations, one with the word "sputum" and the other with the word "spew." This case is intended simply as an illustration of the unpleasant feeling-tone that may hover around a trade-name. It may not be sufficiently widespread to cause any damage to the product, but it would seem advisable to avoid even the risk of unpleasant associations with a product when they could be so easily avoided. The safest way is to ascertain the feeling-tone of a proposed word before adopting it, both by analyzing it for obvious unpleasant associations and by testing it upon a good-sized sampling of people.

The likes, dislikes, tastes and preferences of the consumer enter into the advertising problem in still another way, namely, the choice of an advertising medium and the choice of location in that medium. Surveys of magazines and newspapers indicate differences in the interests and tastes of their subscribers. This is especially obvious in the case of class, sport and other specialty publications. But it is true also in the case of newspapers, where the preference of the professional class inclines toward one, that of the financial

class toward another, and that of the labor class toward still another. As far as the general public is concerned the newspaper offers the most universal medium of approach. A survey⁷ of a typical American city showed that, whereas magazine circulation was limited largely to professional and executive groups, so that unskilled workmen comprising about half of the population received only about one-twelfth of the magazines, practically every family in the city received a newspaper.

The preferences and tastes of the consumer can be capitalized in the choice of position in the medium as well as in the choice of the medium itself. Advertisements which are directed to those interested in sport will profit from their association with sport news, financial advertisements with financial news, and radio advertisements with radio news. The value of such spatial association is not merely in the fact that the chances of being seen by the proper group are enhanced, but by the fact that the advertisements so placed will find their readers in a most susceptible and suggestible mood. Great use is already made of these facts in both advertising and selling, but they will find a still wider range of application when the results of psychological analysis are made available concerning the variation of tastes according to sex, age, occupation, social status and geographical distribution.

WHAT DOES THE CONSUMER BELIEVE?

There is just as great danger of misapprehending the beliefs of the average individual and his basis for them as there is of misjudging his intelligence. In fact, it is difficult to realize what people believe and can be made to believe, with-

⁷ This survey, which appeared in the *J. Walter Thompson News Bulletin*, 1923, No. 192, together with similar data, is reviewed in A. T. Poffenberger, *Psychology in Advertising* (A. W. Shaw Co., Chicago, 1925), Chap. 24.

out definite inquiry into the matter. A great deal of interest has been aroused in this question of beliefs and their basis on account of the ease with which people can be induced to purchase worthless securities and stake their money on propositions where the chances are a thousand to one against them. Drastic state legislation and the constant vigilance of public-spirited business organizations do not always suffice to prevent exploiting the credulity of the public. A thorough understanding of the mechanism of belief will, however, not only show how ill-founded beliefs may be eradicated and prevented, but it will show also how correct beliefs may be established. It is this latter aspect of the matter that has the greatest import for advertising.

The following incident quoted from Starch⁸ illustrates the extent to which their credulity exposes the public to exploitation. A savings bank in its campaign to promote thrift placed this advertisement in its window:

GLORIOUS OPPORTUNITY TO GET RICH QUICK

Invest in

THE CALIFORNIA RANCHING COMPANY

Now being organized to start a cat ranch in California

We are starting a cat ranch in California with 100,000 cats. Each cat will average 12 kittens a year. The cat skins will sell for 30 cents each. One hundred men can skin 5000 cats a day. We figure a daily net profit of over \$10,000.

Now What Shall We Feed the Cats?

We will start a rat ranch next door with 1,000,000 rats. The rats will breed twelve times faster than the cats. So, we'll have rats to feed each day to each cat. Now what shall we feed the rats? We will feed the rats the carcasses of the cats after they have been skinned.

⁸ See D. Starch, *Principles of Advertising* (A. W. Shaw Co., Chicago, 1923), Chaps. 12 and 20.

Now Get This

We feed the rats to the cats, and the cats to the rats, and get the cat skins for nothing. Shares are selling at 5 cents each, but the price will go up soon. Invest while opportunity knocks at your door.

THE CALIFORNIA RANCHING COMPANY

Accompanying the advertisement was the following statement in large letters: "Some gullible people will try to buy this stock. It is a foolish fake, of course, but no more foolish than many 'wild cat' schemes being promoted to-day. Investigate before investing. Don't hand your money over to any unknown glib-tongued salesman." Large crowds gathered in front of the window. People inquired for the stock by mail and in person, and asked for literature about the company. Inquiries of all sorts became so numerous that the advertising had to be removed.

The difficulty that is encountered in the attempt to substitute scientifically established facts for superstitions and to prevent the spread of superstition tends to give additional interest to the search for the basis of beliefs. Even among fairly well-educated people superstitions abound, as several recent inquiries have demonstrated. One of these⁹ showed that, of a large group of college students questioned, about 50 per cent acknowledged superstitious beliefs and practices. Another¹⁰ inquiry among 350 college students revealed similar results. Leaving out of consideration such superstitions as that "Friday is an unlucky day" and such controversial statements as "intelligence is increased by train-

E. S. Conklin, "Superstitious Belief and Practice among College Students," *American Journal of Psychology*, Vol. XXX (1919), pp. 83 f.

¹⁰ H. K. Nixon, "Popular Answers to some Psychological Questions," *American Journal of Psychology*, Vol. XXXVI (1925), pp. 418 f.

ing," it was found that 46 per cent believed that "if you will stare at a person's back you can make him turn around. This is a form of telepathy"; 42 per cent believed "a square jaw is a sign of will-power"; 18 per cent believed that "people born under the influence of certain planets show the influence in their characters."

A study of the mechanism of beliefs in general, and particularly as they are created by advertising, shows that feeling and emotion, rather than reason, play a dominant rôle. Belief is a matter of desire and not of logic. We believe what we want to believe. Hence, it is to be expected that the statement of the truth in advertising or elsewhere will not assure belief. To give a person what he wants and at the same time to arouse a glow of emotion will go far toward creating belief. There are two other factors that should not be neglected; first, any statements that are made should not conflict too sharply with already established beliefs. To create new beliefs contrary to old ones is like breaking old habits and forming new ones, and meets just as much resistance. Second, all statements intended to generate belief should carry the weight of some authority behind them. Herein lies the value of testimonials of great and well-known persons.¹¹

WHAT CAN THE CONSUMER REMEMBER?

Any advertising or selling device which is to furnish a genuine and lasting service must make an enduring impression upon the memory, for there is practically no case where there is not at least some small gap between the marketing effort and the contemplated reaction. The laws of learn-

¹¹For an experimental study of belief, see F. H. Lund, "The Psychology of Belief," *Journal of Abnormal and Social Psychology*, Vol. XX (1925), pp. 63 f.; for a study of belief in advertising see A. T. Poffenberger, "The Conditions of Belief in Advertising," *Journal of Applied Psychology*, Vol. VII (1923), pp. 1 f.

ing and memory which have been discussed in Chapter IV made us familiar with the means of making impressions permanent. It will be profitable, in addition, to analyze some cases of memory for advertising material, to discover, if possible, the potent factors. Two especially appropriate studies are available for this purpose. In both, a list of commodity names was presented to people with the request that they mention the first trade-name that came to mind. Now this is exactly the type of memory that the advertiser wants to guarantee, because it means that, when the need for something arises, his particular brand will offer itself to fulfill it. It does not mean necessarily that the particular brand that comes to mind first will always be bought, for there are many factors that combine to determine the actual purchase. But it is certain that the trade-named article that does not come to mind will not be bought. Now these two experiments measured just what the advertisers had been able to accomplish with their advertising methods upon the typical consumer, in the way of associating the trade-named article with the need of the consumer.¹² Table XLI gives the trade-names mentioned by 1,024 persons to the stimulus word "tooth paste," and gives an interesting picture of the familiarity of the consumer with these different brands in the years 1917-21 when the experiments were made. Over thirty different brands were mentioned. The brand that stands first in the list was mentioned just about five times as often as the one that stands second. In fact, over one-half of all the people called this brand to mind first. The first four brands were mentioned more than four-fifths of the time, leaving only about two hundred responses to be divided

¹² L. R. Geissler, "Association Reactions applied to Ideas of Commercial Brands of Familiar Articles," *Journal of Applied Psychology*, Vol. I (1917), pp. 275 f.; and G. B. Hotchkiss and R. B. Franken, *The Leadership of Advertised Brands* (Doubleday Page and Co., New York, 1923).

among the twenty-five other brands. An analysis of the history of the best known brands of tooth paste and the other commodities revealed the following points:

1. All these brands have been on the market for a long time and many of them are the pioneers in their respective fields.

2. Nearly all are extensively advertised, and nearly every one is the pioneer large advertiser in its field.

3. Nearly every one has been a persistent advertiser during the last ten years.

4. Each one is the largest, or nearly the largest, seller in its field.

5. Nearly all are frequently used commodities.

6. All are products of standard quality and of good reputation.

TABLE XLI. RELATIVE MEMORY VALUE OF TRADE-NAMES

<i>Tooth Paste</i>	<i>Number of Responses</i>
Colgate	539
Pebeco	129
Pepsodent	104
Kolynos	66
Dr. Lyon's	13
Forhan's	12
Klenzo	10
Senreco	8
Peredixo	7
Williams	6
Miscellaneous	52
Blank	78
TOTAL	1,024

Of the devices that make advertising effective, two stand out clearly from this analysis, namely, primacy and repetition. Of the former, little need be said, as one cannot be first in the field of competition by merely wishing it, and at the best it is a matter of good fortune. Repetition, how-

ever, is available for all to use, and is limited only by its cost. There is a certain characteristic of repetition which has been demonstrated both in laboratory studies in the psychology of learning and in advertising, namely, that the memory effects of succeeding repetitions become smaller and smaller. It is this fact that gives learning curves their characteristic shape. The reasons for the decreased efficiency of later repetitions as compared with the earlier ones are numerous and complex, and for our purpose need not be examined. Laboratory studies have shown that, if a given amount of work is to be learned, the first 15 per cent of the repetitions will accomplish about half of the task, while the remaining 85 per cent is needed to complete the second half. These figures can be only approximate, as they vary with the nature of the material to be learned. Studies of the effects of repetition upon the memory for advertising material show that the "diminution of returns" is quite as great as in the more theoretical studies. Strong¹³ conducted an elaborate study of the effects of repetition, in which he duplicated as far as possible the conditions that obtain in advertising. He prepared four pamphlets simulating the advertising sections of four numbers of a magazine. Certain advertisements appeared in only one number, certain others appeared in two of them, while others appeared in the four numbers. All the pamphlets were examined at specified intervals by a group of subjects with the result that some of the advertisements were seen once, some twice and some four times. The subjects were tested for their knowledge of the advertisements after the last number had been examined.

Among other interesting discoveries, he found that two repetitions are worth, not twice as much as one, but only

¹³ E. K. Strong, "The Effect of Size of Advertisements and Frequency of their Presentation," *Psychological Review*, Vol. XXI (1914), pp. 136 f.

about 25 per cent more, and that four repetitions are worth, not four times as much as one, but only about 60 per cent more than one.¹⁴

The advantages of repetition may be retained and its disadvantages counteracted by the introduction of other aids to memory. Thus, it has been found that, if certain unique characters are introduced at every repetition, each will take on the freshness and vividness of a first presentation and raise the memory value of the advertisement considerably. In one study in which all repeated material was varied, four repetitions were worth a little more than four times as much as one, in terms of memory value. This great increase in the value of repetitions is due to the well-known fact of learning, that mere repetition without interest loses its potency. Now, the introduction of new material stirs the interest which would otherwise decrease, and makes the whole experience more vivid.

THE PSYCHOLOGY OF SALESMANSHIP

The foregoing discussion will appear to have been concerned almost entirely with the advertising aspect of marketing. The reasons are found in the difference between the two aspects of marketing which were pointed out at the beginning of this chapter. The materials of advertising lend themselves with special readiness to the analysis and experimental methods of the laboratory. Printed appeals may be collected, presented, handled, dissected, preserved and studied over long periods of time and under constant or known conditions. But the oral appeal of the personal salesman offers problems of far greater complexity. From its very nature the sales talk represents a continuous process of

¹⁴A detailed discussion of these results and of the technique employed in making such measurements may be found in A. T. Poffenberger, *Psychology in Advertising* (A. W. Shaw Co., Chicago, 1925), Chaps. 9 and 20.

which the printed advertisement is but a cross section. When the advertisement is presented its influence is determined once for all, and it is either relatively successful or relatively futile. But the oral salesman, working at close range and face to face with his customer, may choose his appeal, vary it, repeat or supplement it according to the particular idiosyncrasy of the customer and according to the time and circumstance of the interview.

The oral sales talk is to the printed advertisement what the motion picture film is to the simple lantern slide, the drama to the tableau, or the kaleidoscope to the frozen frost pattern. The sales talk is a whole advertising campaign condensed into a few moments and adjusted and adapted to the present responses of the audience. It is not restricted to its verbal dress, but is reënforced, emphasized, or otherwise modified by the personality of the salesman, his appearance, voice, dress, bearing, expression, intonation and gesture. Once it is finished it may never occur again in precisely the same form or under precisely the same conditions.

For these and other reasons, while much reference has been made to the psychology of salesmanship, there cannot be said to exist any considerable body of facts, principles or methods which differ from the established laws, results and technique of the psychology of advertising. There is, indeed, reason to believe that the principles of successful salesmanship are no different from those underlying the successful advertisement, sales letter or window display. But their operation in any given instance is obviously much more obscure and complex.¹⁵

The salesman no longer looks upon the act of selling as

¹⁵ Recent successful efforts to build up a psychology of salesmanship may be found in E. K. Strong, *Psychology of Selling and Advertising* (McGraw-Hill Book Co., New York, 1925); and A. J. Snow, *Psychology in Personal Selling* (A. W. Shaw Co., Chicago, 1926).

a single event. He is accustomed in his own preparation, in sales instruction, and to greater or less degree in actual performance, to analyze the process into various elements, steps or stages, such as preparation, approach, presentation, argument, closing the deal, etc. And in so far as psychological measurement is able to specify the relative strength or persuasiveness of various sales points or bases of appeal, he may with profit utilize the results of such methods. For the most part, however, as matters now stand, the salesman can best profit from psychology by familiarizing himself in an expert way with the original and acquired tendencies of human beings, the mechanisms of conduct, thought and feeling, the range of individual differences in interest, values, motive and temperament, the general lore and doctrine of expression, emotion, belief and reflection, and especially with the laws of cogent reasoning, the fallacies of argument, and the instinctive promptings underlying such factors as suggestion, resistance, conflict and decision. To control human behavior, one must understand it.

In so far as the personality of the salesman enters into the sales function, a new set of psychological problems arise which have to do with the characteristics of the salesman that contribute to success in selling. Such factors as physique, health, temperament, age, manner of dress, etc., may be found to be important factors in the use of persuasion, suggestion and argument. Some of these are doubtless native and unchangeable while others are subject to cultivation.¹⁹ An interesting venture in applied psychology will have to do with the diagnosis, by the various means of mental measurement, of the personal traits which combine to form the successful salesman. It will have to do also with the discovery to what degree such particular qualities or aptitudes are

¹⁹ The characteristics of the salesperson are discussed in the systematic treatment of salesmanship by A. J. Snow in *Psychology in Personal Selling* (A. W. Shaw Co., Chicago, 1926).

original traits and to what degree they may be acquired. It will have to do further with the conditions of practice and instruction through which the desired characteristics may be most economically and effectively communicated.

CHAPTER XXIII

PSYCHOLOGY AND THE LAW: I. THE PREVENTION OF CRIME

THE law as a device for the control of human conduct touches upon every aspect of psychological research. From the historical point of view the regulation of behavior by law was at first solely a matter of punishment for wrong-doing, for the purpose of vengeance or retribution. At a later period the interest shifted to the repression of crime, and the reformation of the criminal. The final stage of evolution which is beginning to absorb the maximum of interest is in the direction of the prevention of crime.¹ The reverse order will be followed in examining the psychological aspects of the law, since psychology has a peculiarly strong interest in questions of crime prevention. The problems that are not touched upon in the discussion of crime prevention will be considered under the heads of the detection of crime and its treatment.

INDIVIDUALITY IN LAW

The application of psychology to practical human problems has everywhere forced attention, as we have seen, upon the individual, so that his characteristics are made to determine procedure in which he is involved. The law is no exception. There has been, however, a form of individu-

¹Of the many books dealing with the various aspects of crime, the following two are readable examples: M. Parmelee, *Criminology* (The Macmillan Co., New York, 1918); and F. H. Wines, *Punishment and Reformation* (revised edition, Thomas Y. Crowell Co., New York, 1919).

ality common in legal procedure, which is non-psychological and which should not be confused with a technique based upon a recognition of the essential characteristics of human behavior. For instance, individuality was said to be the dominant principle in France before the Revolution when the judge was the sole determiner of what the punishment for crime should be. The individuality of the condemned person might have been given consideration but in practice the punishment was chosen to fit the crime rather than to fit the criminal. The tendency of the judge to disregard the character of the offender and to be unduly severe in punishment led to the establishment of a fixed punishment for each crime. This was a distinct improvement for the offender, even though it tended in a direction away from the so-called individuality.

A shift of emphasis in which the individual becomes the unit of action implies a thoroughgoing knowledge of the nature of human conduct and the factors on which it depends. The availability of this knowledge and the increasing readiness to see its applicability to the law are making important and far-reaching changes in legal technique. The recognition of profound differences between the child and the adult has led to the organization of children's courts, where the whole machinery of the law is better adapted to the handling of their problems. Cognizance is being taken likewise of the differences between men and women offenders, between first offenders and repeaters. Distinction is made between the various kinds of criminal acts and the treatment they should receive. The most obvious innovations based upon the psychology of the individual are the indeterminate sentence, parole and the suspended sentence. By the proper use of these devices, the treatment may be planned according to the nature of the individual case rather than according to the crime committed.

The psychology of the individual will not be limited in its

application merely to the individual offender. It should extend to all individuals involved in the processes of the law. Where the jury system is in force, the psychology of the jurymen offers some very interesting problems. What is the capacity of the jurymen to grasp the details of a case as they are presented; what is his ability to organize and weigh the details in arriving at an opinion; what is the influence of one dominating jurymen upon the judgment of all the others? These and many other pertinent questions might be raised. The judge, too, would be found, upon investigation, to have an individuality which reflects itself in his judgments and makes them different from those of every other judge.

INDIVIDUALITY AND RESPONSIBILITY

The facts of individuality have their greatest application in the determination of the causes of crime and the discovery of the point where the responsibility for crime should rest. All the facts of modern psychology lead to the conclusion that behavior at any moment is the product of a great number of contributing circumstances both within and without the individual, and that in no sense is he entirely free to choose his actions. From the psychological point of view, criminal behavior does not differ from normal behavior and is, therefore, subject to the same laws of cause and effect. In order to prevent any given reaction, control must be exercised over the causal factors and the circumstances of behavior must be modified. Likewise, in order to modify any form of behavior, as, for example, in the reformation of a criminal, the same facts of cause and effect must be recognized, and the process of reorganizing habits of action and habits of thought must be carried through as in any form of learning. The questions of responsibility for crime and the punishment of the responsible person, are secondary in importance to the question of the causes of criminal action, and the exercise of such control and treatment of the individual that

further criminal action may be prevented in those who are already offenders, and that original offenses may be forestalled in all other cases.

THE CAUSES OF CRIMINAL BEHAVIOR

Every human action, except those which are obviously automatic, may be analyzed into a number of factors, and its cause into a number of partial causes. Thus, there is a motive or impulse behind every act, which may, in itself, be strong or weak. The impulse to eat immediately after a big dinner is reduced almost to zero strength, while the same impulse after two days of fasting may assume tremendous force. The nature of these impulses and their variety has been discussed in Chapter II. Such impulses do not always lead to overt action, because they are subject to restraint or inhibition. One may, for example, have a strong impulse to eat, but may check it and refrain from eating, because it is not his regular meal-time, because it is against his doctor's orders, because it is a period for religious fasting, because he does not have the money to purchase food. Finally, he may not eat because his immediate environment does not afford the edible substances necessary for the reaction. Superimposed upon these tendencies is the capacity to foresee the consequences to which satisfaction of the impulse will lead. To return to the food-taking illustration, the individual who is instructed by his physician not to partake of food may not be able to see far enough into the future to realize the consequences for his health of indulging his impulse. Thus we get a glimpse of the composite of circumstances upon which our choice of any course of action depends. There is the strength of the impulse to act, the strength of the inhibiting or facilitating influences within the individual, the intelligence and information requisite to knowledge of consequences, and the environmental factors either furthering or hindering the reac-

tion. Each of these items is merely the name for a complex of separate and distinct factors. Any particular act may be the result of a number of combinations of circumstances. Thus the act of stealing a loaf of bread may follow from (1) an overpowering impulse due to hunger, (2) a moderate impulse uninhibited by any social or ethical considerations, (3) a moderate impulse with moderate restraint, but an environmental situation inviting theft. Although, objectively, the act of theft is the same, from the point of view of the individual and his treatment each case is entirely different from every other.

This attitude toward criminal behavior is in strong contrast to the legal point of view, according to which every individual is responsible for his behavior, if he knows the nature and quality of his acts. Furthermore, he is said to know the nature and quality of his acts if he cannot be proven insane. A growing recognition of the weakness of such an interpretation is evident in the recourse to the plea of temporary insanity, "brainstorm," absence of moral responsibility, and in very rare cases to the plea of feeble-mindedness. A change to the psychological point of view does not imply a sentimental coddling of the offender and a disregard of the social defense. The preventive measures which rest upon a thorough psychological foundation and which call for treatment of the individual according to his symptoms will provide the maximum social defense. For there will be no attempt to reform those who cannot be reformed, or to return to a social environment those who lack the prerequisites for normal social behavior.

INTELLIGENCE AND DELINQUENCY

According to our analysis of behavior, mental deficiency, with its lack of ability to foresee the consequences of a given course of behavior and the resulting inability to see the rightness or wrongness of it, would be a contributing factor in

TABLE XLII. DISTRIBUTION OF INTELLIGENCE AMONG
DELINQUENTS

Number	Intellectual Age	Chronological Age
1	8	An average of 18.5 years
12	9	
14	10	
14	11	
11	12	
4	13	

delinquency. The mental examination of individuals in prisons, reformatories, houses of detention and courts leads to the belief in a very close relation between mental deficiency and crime. The figures for one hundred cases brought to the juvenile courts for offenses serious enough to warrant detention, and which were examined by means of standard scales for the measurement of intellectual age, may be cited as an illustration. The misdemeanors had been various—such as stealing, immorality and incorrigibility. The ninety-seventh child tested was found to be normal, all the rest of the hundred being shown to be mentally defective. Only thirty-four were less than four years backward, a retardation suggested as the extreme limit for possible responsibility and normality. Sixty-six cases were feeble-minded, from four to eight years backward. The average chronological age of the group of one hundred was 13.8 years; the average mental age, according to the tests, was 9.2 years.

In another case fifty-six inmates of a girls' reformatory were similarly tested. The ages ranged from fourteen to twenty, averaging 18.5. According to the tests for intellectual age, they measured as shown in Table XLII.

Goddard,² the investigator reporting these results, remarks in discussing their significance:

² H. H. Goddard, *Feeble-mindedness: Its Causes and Consequences* (The Macmillan Co., New York, 1914).

"As the tests for thirteen years have been demonstrated to be much more difficult than that age would indicate, we may say that four out of the fifty-six are not feeble-minded, as we usually define feeble-mindedness. The rest are clearly mental defectives."

Table XLIII shows the proportion of the inmates of various reformatories and refuges who are by actual examination found to be mentally deficient.

TABLE XLIII. MENTAL DEFECTIVES IN INSTITUTIONS

<i>Institution</i>	<i>Per Cent Defective</i>
St. Cloud, Minnesota, Reformatory	54
Rahway, New Jersey, Reformatory	46
Bedford, New York, Reformatory	80
Lancaster, Massachusetts, Girls' Reformatory	60
Lancaster, Massachusetts, Paroled Girls	82
Westboro, Massachusetts, Lyman School for Boys	28
Pentonville, Illinois, Juveniles	40
Massachusetts Reformatory, Concord	52
Newark, New Jersey, Juvenile Court	66
Elmira, New York, Reformatory	70
Geneva, Illinois	89
Ohio Boys' School	70
Ohio Girls' School	70
Virginia, three reformatories	79
New Jersey State Home for Girls	75
Glenn Mills Schools, Pennsylvania, Girls	72

Especially in the case of women and girls is mental deficiency likely to involve some catastrophe which labels the unfortunate person as a delinquent. Prostitution, abandonment of children, illegitimate parenthood, cruelty, vagrancy, are all of them dependent to a considerable degree on the feeble-mindedness of the women and girls involved, and the consequent ease with which they are preyed on by unscrupulous or equally feeble-minded men and boys. The feeble-

minded girl or woman is a particularly grave social problem for various reasons. The non-competitive character of the work into which women traditionally drift means a small likelihood of the detection of feeble-mindedness except under conditions of special attention or catastrophe. Further, we are now coming to realize that feeble-minded parents mean feeble-minded offspring.

By way of illustration may be given the results of a study of 1,000 consecutive cases brought to the Clearing House of Mental Defectives of New York City.³ Of these 1,000 cases, 568 were males and 432 females. Table XLIV shows the relation between mental age and actual age at the time of examination, for each sex separately.

TABLE XLIV. RELATION BETWEEN MENTAL AGE AND ACTUAL AGE AT THE TIME OF EXAMINATION

MENTAL AGE	ACTUAL AGE WHEN BROUGHT TO THE CLEARING HOUSE					
	Males			Females		
	Average	A. D.	Cases	Average	A. D.	Cases
Years (Binet)						
0-4	7.1	3.2	92	8.1	3.8	65
4-5	9.2	2.4	29	11.4	4.3	16
5-6	12.6	4.2	25	13.2	4.3	32
6-7	11.4	2.9	42	15.8	6.0	40
7-8	13.5	2.9	76	15.0	4.6	45
8-9	12.9	2.5	82	17.2	5.1	56
9-10	14.0	2.7	70	17.3	4.3	53
10-11	15.2	2.7	57	18.5	5.4	46
11-12	14.2	1.0	20	17.7	2.5	27
12 +	13.0	0.0	4	16.8	2.9	6

The facts are as follows:

³L. S. Hollingworth, "The Frequency of Amentia as Related to Sex," *Medical Record* (October 25, 1913).

1. More males than females are brought to the Clearing House, in a ratio of about 1.3 to 1.0.

2. At the age of 1-2 years the frequency for males and females is equal. From the age of 2 to the age of 16 there is a very marked preponderance of males. At the age of 16 the curves cross and from that point on there is a very marked preponderance of females.

3. Females survive in the social *milieu* till beyond the age of 16 years twice as frequently as do males; females survive in the social *milieu* till beyond the age of 30 years three times as frequently as males.

4. The Binet measuring scale shows that for all mental ages the average actual age at examination is older for girls than for boys—this difference becoming very marked after the mental age of 6 years.

The figures show, for instance, that a female with a mental age of 6 years survives in society about as well as a male with a mental age of 10 or 11 years.

5. The average deviations from the above averages are greater in all cases for girls than for boys, indicating that any male is much more certain to be brought to the Clearing House at a given average age than is a female of the same degree of defectiveness.

6. Of the 159 women over 16 years of age, the majority had found a more or less secure economic basis for survival either in housework or in prostitution.

Commenting on the significance of these facts, the investigator writes as follows:

These facts are interesting and significant for all who are immediately or remotely concerned with social problems. To interpret them we have but to reflect on our social organization. Women are not a competitive class. Their work is housework, performed in isolation and not in competition with others for a wage. Moreover, in our social organization, sex as such may easily become a commercial asset to women, and opens

to them ways wherein they can survive without much regard to mental deficiency. Men, on the other hand, form a highly competitive class, working together in competition, for a wage. The boy who cannot compete mentally becomes at an early age an object of concern to relatives, is brought to the clinic and is directed toward an institution. The girl who cannot compete mentally is not so often recognized as definitely defective, since it is not unnatural for her to drop into the isolation of the home where she can "take care of" small children, peel potatoes, scrub, etc. If physically passable, as is often the case, she may marry, thus fastening herself to economic support; or she may become a prostitute, to which economic pursuit feeble mentality is no barrier. Thus they survive outside of institutions. Our data here reveal how accidental are the causes which finally bring them after thirty years to the Clearing House. The writer has frequently questioned those who accompany them when they come. Answers like these are typical: "Her husband has just died"; "She got rheumatism and can scrub no more"; "She was a prostitute but physical illness has driven her from the street." No one can doubt that there are scores of feeble-minded women at large to whom these accidents have not happened.

Contrasting sharply with the foregoing studies is the report of Murchison^{*} upon the intelligence of inmates of five state penitentiaries whom he tested (with the Army Alpha intelligence examination) and compared with the adult male white population comprising the draft during the war. Some of his data are reproduced in Table XLV. The first column shows the familiar letter grades according to which intelligence was classified in the army, the second column gives the per cent of criminal cases falling within each letter grade, the third column gives the same for the total white draft in the United States, and the fourth column gives the same for that portion of the draft drawn from the five states where the penitentiary cases were studied. After making allowances for certain factors of selection, the author con-

^{*}C. Murchison, *Criminal Intelligence* (Clark University, Worcester, Mass, 1926).

TABLE XLV. INTELLIGENCE OF CRIMINALS FOUND IN PENITENTIARIES

	Percentage of Criminal Cases	Percentage of White Draft	Percentage of White Draft in the Five States
A	5.3	5.1	5.8
B	11.4	9.7	11.0
C +	22.8	18.8	19.4
C	28.5	28.7	29.3
C -	17.8	21.4	20.0
D	6.9	8.8	7.9
E	7.5	7.5	6.3

cludes that the criminals examined by him have an intellectual status equivalent to that of the normal white population.

It may be admitted that the figures obtained from reform institutions and women's and children's courts tend to exaggerate the importance of mental deficiency as a causative factor, if for no other reason than that one finds there only those delinquents whose low intelligence did not enable them to escape or cover up their delinquency. It is probable also that these institutions receive cases which are guilty of minor crimes such as low-grade intellects are likely to commit. On the other hand, the penitentiary cases comprise a select group who are likely to fall within the upper levels of the criminal population. That the intelligence does vary considerably with the type of crime is clear from the data shown in Table XLVI, which are also taken from Murchison. The criminals are here divided into seven classes, and the intelligence of each class is expressed in intelligence grades, just as in Table XLV. More than half of the individuals committing crimes of fraud are of superior intelligence, while about half of the sex offenders are of inferior intelligence.

TABLE XLVI. DISTRIBUTION OF INTELLIGENCE ACCORDING TO TYPE OF CRIME

	Normal Five States	Fraud	Force	Thiev- ing	Statu- tory	Phys- ical Injury	Dere- liction	Sex
A	5.8	12.3	4.8	4.3	3.2	4.8	4.2	4.0
B	11.0	15.8	11.9	11.3	11.2	8.7	12.6	8.4
C +	19.4	24.8	23.8	25.1	20.3	21.5	18.5	13.9
C	29.3	25.1	29.6	27.6	34.2	28.3	21.8	26.6
C -	20.0	11.4	18.6	17.2	17.1	19.6	20.3	22.6
D	7.9	8.2	5.7	7.3	7.5	7.0	7.6	10.7
E	6.3	2.4	6.3	7.3	6.4	10.3	15.2	14.3
No. cases ...	...	331	1,542	992	187	521	119	253

In order, therefore, to get a true picture of the relation between intelligence and criminal behavior it would be necessary to combine the studies of cases from penitentiaries and all other types of institutions. Three facts seem demonstrated. First, not all crime is due to mental deficiency, for in practically every institution there are criminals who are not mentally defective. Hence other factors contributing to criminal behavior must be diligently sought. Second, not all defectives are delinquent. Females and males who live sheltered lives in a sufficiently simple environment do not necessarily become delinquent. The findings of the New York State Commission for Mental Defectives⁵ bear out this statement. A survey of the State shows that about one-half of one per cent of the total population is defective. An examination of these cases gives a picture which should be studied in connection with the reports of deficiency in

⁵ K. G. Ecob, "New York State's Accomplishments and Immediate Aims in Extra-Institutional Care of Mental Defectives," Proceedings of the 48th Annual Session of the American Association for the Study of the Feeble-Minded, 1924.

institutions for delinquent cases. A sampling of 412 cases referred to the state clinics were classified as shown in Figure 44. This classification is more or less subjective but represents the opinion of each case gleaned from consultation with the family and teachers, and from a mental examination. The

Cases

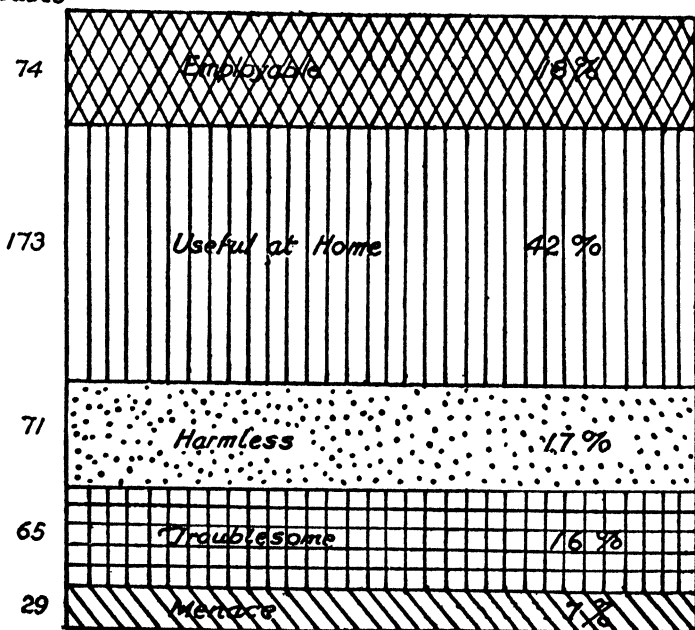


FIG. 44. STATUS OF MENTAL DEFECTIVES IN THE STATE OF NEW YORK

"employable" group includes those that were at the time of examination or had been previously employed at a wage ranging from \$1.25 to \$25 per week. The group marked "useful at home" includes those that are able to do such work as care for children, general housework and odd jobs. The "harmless" group includes stable low-grade individuals that have about the same status in the family as young normal

children. The "troublesome" group comprises unstable cases, many having delinquent tendencies. This group includes also those who are troublesome because of the excessive amount of physical care that they require. The "menace" group includes cases "showing definite antisocial behavior and also those with poor supervision, unable to protect themselves from unscrupulous persons." The "troublesome" group and the "menace" group together comprise only 23 per cent of the defectives, while nearly as large a percentage is found to be employable. In a similar survey of 415 lower grade cases (75 per cent being imbecile or below) the classification was as follows:

Employable	18 per cent
Useful at home	11 per cent
Harmless	26 per cent
Troublesome	37 per cent
Menace	8 per cent

Even here, only 45 per cent of the cases are troublesome or worse, a good proportion of whom are so classified because their low grade makes them a physical burden.

The third fact disclosed by these studies is that defectives may be prevented from becoming delinquents, at least in a majority of the cases, by provision of the proper care and supervision. Those cases that show antisocial tendencies can be cared for best in institutions adapted to the purpose. The other cases can be sufficiently supervised without institutional care. What seems to be most essential from the point of view of crime prevention is the discovery of mental defectives in their early years, a follow-up of their progress and a diagnosis at their entrance into adulthood as to the class into which they fall and the treatment that they should receive. By such means they will receive attention before, rather than after, they have become criminals. As the discovery of intellectual status is most readily made in con-

nection with educational progress, the task of classification and supervision of the careers of these cases might well become a part of the system of public instruction. Such supervision should include all children, both those in school and those who, on account of defect or for any other reason, do not attend school. A program of this sort might well be the outcome of the work already begun by the agencies dealing with defectives. It becomes increasingly feasible with the wider and wider use of the intelligence examination as a part of the regular school program.

IMPULSE AND CRIME

Among the factors determining behavior is the powerful impulse to act which overrides all resistance. As stated earlier, these impulses may lead to good or ill, but wherever there are unchecked impulses of this type, there is at least the likelihood of criminal behavior. Perhaps the clearest and most notorious cases of this sort are to be found among the kleptomaniacs and the pyromaniacs. The former seem to have an uncontrollable impulse to take things. Usually what is taken is not needed. This behavior occurs frequently in persons whose whole environment and whose associations would tend to inhibit such actions. Likewise, the pyromaniac will set fire to things, without malice or the intent to rob, but simply because he cannot help doing so when the impulse develops. The sex offenders are frequently of this type, and their behavior resembles that of the maniac. The student of behavior recognizes these phenomena as exaggerations of the normal native impulses.

Closely related to these forms of impulsive behavior is that of the paranoiac who acts upon a fixed and impelling idea. If this idea happens to be that he is a very superior being, his behavior may be ridiculous and harmless, but if it happens to be an idea of persecution, he may commit murder to "protect" himself. The psychological analysis of juvenile

delinquents, such as is made by Healy⁶ and his associates, shows the frequency of such impulsions in antisocial behavior. The onset of mental diseases often manifests itself in outbreaks of ungovernable impulses, as in dementia præcox and paresis.⁷

The prevention of criminal acts due to ungovernable impulses presents a particularly difficult problem in some respects. In the pathological cases, the criminal act very often furnishes one of the earliest symptoms of the disease. What is needed, then, is the discovery of more sensitive methods of diagnosis than are at present available, in order that criminal acts may be forestalled. Many inexcusable crimes are constantly occurring because persons known to have ungovernable criminal impulses are allowed complete freedom, or are placed under the inadequate supervision of their families. Many are imprisoned for such acts and are released after a short term with no improvement in their condition and with full opportunity to repeat their crimes. A thorough understanding of the psychological characteristics of these persons will initiate a form of treatment that will prevent at least any but first offenses. Where the situation is complicated, as it frequently is, by mental deficiency or by deficiencies in training, prevention may be more readily secured by early discovery of these conditions and by proper supervision thereafter.

CAPACITY FOR RESTRAINT

There is an important psychological difference between behavior due to an overpowering impulse that breaks through all resistance and that due to a moderately strong impulse

⁶ W. Healy, *Mental Conflicts and Misconduct* (Little Brown and Co., Boston, 1917); also *Pathological Lying, Accusation and Swindling* (Little Brown and Co., Boston, 1915).

⁷ For material of this character see Rosanoff-Defursac, *Manual of Psychiatry* (Wiley, New York, 1919, fifth edition).

that meets only weak opposition or no opposition at all. The difference has been demonstrated experimentally by Crane,⁸ in his measurements of differences in the fear reactions of whites and Negroes. By the use of an ingenious technique, he measured both the withdrawal of the hand from an impending stimulus and the commotion within the muscle when the actual withdrawal movement was inhibited. He found that, whereas the fear impulse was stronger in whites than in Negroes, the overt reaction was less pronounced in whites because of their greater power of inhibition directed to the suppression of these movements. There were pronounced individual as well as racial differences disclosed. It is possible, as this experiment partially suggests, that there may be native differences in inhibitory capacities as well as in the strength of impulses. But the major influences working toward suppression of impulses come from training, under the name of custom, religion, social pressure, morale, fashion. That is, a body of mental and motor habits may be built up which will counteract the native and acquired impulses toward antisocial behavior. To quote from Münsterberg:⁹

How does the honest man succeed in living an honest life? Impressions and thoughts carry to his mind numberless ideas which awake feelings of pleasure and displeasure. The pleasurable idea stirs up the desire and the impulse to realize it in action, and the disagreeable idea awakes the impulse to get rid of the displeasing source. There is no further will act necessary; the idea of the end itself presses the brain button and makes us act. We approach the attractive and escape the painful by the mere power of the ideas; the whole development of life from the first sucking for sweet milk is possible only through this mechanism. But from the beginning life complicates this process. The tempting idea of the end to be

⁸ A. L. Crane, "Race Differences in Inhibition," *Archives of Psychology*, No. 63 (1923).

⁹ H. Münsterberg, *On the Witness Stand* (Clark, Boardman and Co., Ltd., New York, 1923), p. 236.

reached awakes, before the action sets in, some counter idea, perhaps the thought of dangerous results; we desire the fruit, but we know it is poisonous, and the idea of poisoning works in the opposite direction. The attractive impression gives the impulse to extend the arm, and the thought of danger gives the counter impulse to withdraw the arm. The one tends to inhibit the other; the more vivid idea overpowers the weaker one; we do not grasp for the poisonous fruit, because the danger holds us back.

The inhibitory ideas regulating our everyday conduct are numerous and varied—the fear of spending eternity in hell, the fear of the electric chair, of punishment by imprisonment, the prospect of a suit for damages, of facing arrest, of loss of position or social status, the likelihood of public ridicule, or of loss of one's own self-esteem are such deterrents. Habits of thought and action in accordance with accepted principles of morality instilled through years of training and example must not be underestimated as checks against anti-social ideas. The answer of persons so trained to suggestions of antisocial behavior would probably be, "Why, I could not think of doing such a thing!"

The fear of punishment as a deterrent of criminal and prohibited acts, and punishment as a form of treatment for offenders have played such an important part in legal procedure that discussion of it will be reserved for the chapter dealing with the treatment of the criminal.

Inhibitory ideas and habits do not blossom spontaneously in the human mind, but must be implanted by the process of training. Those individuals who possess the normal human impulses adapted to the simple social existence of primitive man, but who are deprived of the guiding and molding influences necessary to fit them for our modern and highly complicated society are easily drawn to crime. The greatest preventives of crime, which results from the lack of these inhibitions, are early social education such as can be provided by movements like the Boy Scouts, Camp Fire Girls,

and public school activities, and by raising the general standards of living, by increasing the understanding of the need for laws and by developing a respect for them. There is being forced upon the public consciousness to-day the recognition that mere prohibition and suppression of impulses by force do not accomplish the ends desired. In fact, the teachings of Freud that suppression of impulses by force will lead to violent outbreaks, and that these same impulses may be sublimated or educated into useful channels may be applied to the technique of prevention and treatment of crime as well as to the field of prevention and treatment of disease. For those individuals whose limitations of native intelligence prevent or impede such education, the remedy has already been prescribed.

ENVIRONMENTAL INFLUENCES AND CRIME

There remain for consideration those factors affecting behavior which may be grouped under the head of environment, exclusive of education and social influences, which might be so designated. Innumerable environmental conditions have been made responsible for crime at various times. Healy¹⁰ found that conditions in the home were next to the most frequent causative factors in the 823 delinquents examined by him, the most frequent cause being the mental abnormalities and peculiarities of the individual. The method of correlation long ago disclosed a certain relationship between amounts of crime and geographical location, climate, season of the year, and weather conditions. High temperatures are said to increase the number of crimes against the person, because of the general irritability and emotional unrest produced by excessive heat, and also because the nature of the outdoor life that is encouraged by warm temperatures facili-

¹⁰ W. Healy, *The Individual Delinquent* (Little Brown and Co., Boston, 1915), pp. 130 ff.

tates crime of that sort. On the other hand, it is said that low temperatures encourage crimes against property because of the greater need in low temperatures for food, shelter and clothing, and the greater difficulty of getting these necessities. The long nights of winter, too, offer more opportunity for crimes against property such as theft and burglary. Such conclusions as these are supported by statistical studies of crime in different sections of the United States, in different countries, and in the same neighborhood at different seasons of the year. The weather is held responsible for criminal acts, in the sense that certain weather conditions are productive of health and make possible an increase in the reserve supply of human energy. This excess of energy may, of course, be directed to some useful purpose, but, if it is not, will lead to criminal acts. These influences are, to say the least, very indirect and cannot play more than a secondary rôle in the causation of crime.¹¹

There are, however, more tangible environmental influences which deserve consideration because they tend to reduce the power of restraint. Among these are drugs and stimulants and various agencies that possess a strong suggestive influence. It is true, perhaps, that none of these will have any great potency over the individual who is normally constituted as to intelligence, strength of impulses and power of inhibition, but for the persons who have a "borderline" intelligence, and whose behavior determinants are otherwise delicately balanced, they may be the provocative stimuli in the direction of criminal actions. Alcohol is particularly notorious as a means of depressing the factor of control, and of freeing the individual from "hampering" inhibitions. The matter becomes doubly significant when it is recalled that alcoholism is more frequent in those persons who tend to be

¹¹ See E. Huntington, *Civilization and Climate* (Yale University Press, Connecticut, 1915), and E. G. Dexter, *Weather Influences* (The Macmillan Co., New York, 1914).

unstable and inadequate to meet their social obligations. Even though the proportion of the population thus adversely affected is relatively small, the prevention of crime would necessitate the careful regulation or prohibition of the use of alcohol. The case is even clearer in regard to opium, cocaine and other habit-forming drugs, which are already under severe control.

The influence of suggestion is more subtle and difficult to trace. Its effects are greatest upon young persons and those who, though of adult age physically, are mentally retarded. Statistics gathered within recent years show that criminals are recruited from the very young and from the mentally retarded portion of the population. It need not be presumed that suggestions carried by such mediums as the public press, magazine stories and motion pictures are directly responsible for the crimes of the young, but merely that such young persons with criminal interests are the ones most readily directed by the force of suggestion.

One needs only to recall the epidemics of suicide and murder by such means as cyanide of potassium, chloride of mercury, carbolic acid and the like; to notice the likenesses in the technique of burglars at different periods of time; to note the cases of false testimony in court and false confessions of crime, to realize the great suggestibility of such persons and their lack of foresight. Unlike the normal adult, they are unable to resist the suggestions of advertisements, posters, newspapers and magazines, and of their associates. Naturally these traits may be played upon either for good or evil. One who knows the mechanism of suggestion would expect the prevalence of crime, especially when it is advertised by these agencies of publicity, to breed more crime.

There are many sources of evil suggestions which cannot be eliminated, so long as there are immoral and antisocial persons, and to that extent the atmosphere in which children develop and the feeble-minded live, must remain far below the ideal. But that is a good reason why those evils which can be eliminated should be. Such organs of publicity as motion pic-

tures, newspapers, magazines, advertising posters and the like, should not be allowed to contribute to the necessary burden of evil suggestion by the character of their productions. The purely commercial spirit should be tempered by a spirit of social welfare and education.²²

Recognition of the significance of these influences is not lacking. Newspapers of the better grade censor their items of criminal news, and present them in their correct social perspective. Those that do not do so are subject to attacks by legislative and other public bodies, which call for a decrease in amount of space devoted to crime news and a reduction in the size of headline by which such items shall be introduced. The general tone of motion pictures has been raised so that they are much less subject than they were in the earlier days to public criticism and censorship. Much still remains to be done among certain classes of publicity devices for the protection of the highly suggestible portion of the population.

There are certain environmental influences that are difficult to classify, but which lead to the creation of the "casual" criminal. In the discussion of intelligence defects and their relation to crime, it was pointed out that defective mentalities are not adequate to meet competition and survive by straightforward efforts in the highly complicated social life of to-day. They are driven frequently to compensate for their defects by illegitimate and criminal methods. It happens, too, that individuals who have been successful in their social and human contacts for years will be unable to meet sudden and extreme emergencies in their careers. The war demonstrated clearly that "normal" is only a relative term, for thousands of people who adapted themselves perfectly in times of peace could not meet the changed conditions induced by the war in the same straightforward fashion. "Shell shock" occurred in

²² A. T. Poffenberger, "Motion Pictures and Crime," *Scientific Monthly*, April, 1921.

the trenches, and "war shock" far from the field of battle and in all lines of work. Prolonged sickness in the home, business disasters, the lure of the "opportunity of a lifetime," and many other crises serve to strengthen impulses or to lessen the powers of inhibition and lead to irregular or reprehensible conduct. Such sporadic criminal outbreaks are difficult to prevent because in the individual case they cannot be foreseen. But, at least, precautions can be taken to guarantee that such persons are not molded into repeaters or confirmed criminals as a result of the treatment for their first offense.

This survey of the psychological factors in criminal behavior demonstrates that it is not easy to fix responsibility for crime and that prevention presents a large social problem. Criminals are not born as such. The behavior mechanisms which lead to crime are the same as those which lead to useful service. Crime develops in the interaction between the individual and his environment. Preventive measures must be directed both to the individual and to his environment. Those individuals that are born too poorly equipped to meet the fundamental problems of life must be cared for, and those environmental conditions that are too involved to be overcome by persons above a certain level of native deficiency must be regulated accordingly. Considerable interest attaches to the eugenics movement as a crime preventive. The measures for preventing the procreation of individuals who by their heredity will be predisposed to crime, which were discussed in Chapter III, will become more serviceable as our knowledge of inherited traits increases. Up to the present their value is limited because of the limitation of public understanding and support. The most hopeful course of action lies in a growing knowledge of the mechanism of behavior, of the factors that direct it toward useful or harmful ends, and of the control of these factors.

CHAPTER XXIV

PSYCHOLOGY AND THE LAW: II. THE DETERMINATION OF GUILT

A FERTILE field for the extensive application of psychology to legal procedure is in connection with the determination of guilt: the taking of testimony and evaluation of evidence. All the mental processes are involved in these functions, and definite limits are set to the quality and quantity of the testimony by the character of the mental processes of those who testify. To attempt to exceed the normal limits of sensory acuity, of perception, of judgment, of memory and of reasoning, will be certain to introduce confusion and error. It is not fair to a witness to demand from him greater accuracy of report and range of information than his capacity makes possible. These matters have received considerable attention in the history of law. The ancients were sufficiently interested to enumerate various illusions of perception to which observers are liable. Especially during the last 100 years there have appeared from the hands of jurists, lawyers and psychologists a great variety of treatises, discussions and reports bearing on what Bentham, in 1800, called "the psychological causes of correctness and completeness in testimony." The nature of perception, its tendencies, determinants, characteristics, accuracy and individuality bulk large in every textbook of psychology and in every consideration of "judicial evidence." The newspaper account of almost any trial in which sincere witnesses independently report their versions of an event will disclose in a most instructive way the importance to judge, law-

yer and jury of a knowledge of the psychology of attention, perception, memory, imagination, suggestion and belief. At the same time, a detailed examination of such a newspaper account, as to the nature of the questions asked, the manner of asking them, the type of information demanded of the witness, etc., will show that available knowledge of these psychological processes is frequently disregarded.

INDIVIDUAL DIFFERENCES IN CAPACITY TO GIVE TESTIMONY

In recent years numerous investigations, initially suggested by the work of Cattell, Binet, Stern and others,¹ have endeavored to go beyond the general exposition of the psychological tendencies involved, and to secure precise measurements of them. Setting out from the well-known fact that observation, memory and report are all liable to error—error on the part of the observer, error in the processes of recollection and memory, difficulties in the process of communication, and errors of interpretation on the part of the listener—they have attempted to determine by exact experimental methods the nature, degree and causes of these errors and their dependence on such factors as individual difference, age, sex, practice, intelligence, time interval, mode of report and degree of suggestion.

In addition to a general knowledge of the mental functions, it is necessary to know the way in which one individual differs from another, and above all, to have some indication of the particular qualifications of each witness who gives evidence, so that what he reports may be properly evaluated. It has been suggested by students of criminology² that the

¹A good review of the literature on the psychology of testimony will be found in G. M. Whipple, *Manual of Mental and Physical Tests* (Warwick & York, Inc., Baltimore, 1915), pp. 375 ff.

²See M. Parmelee, *Criminology* (The Macmillan Co., New York, 1918), Chap. 18.

proper handling of witnesses requires that a psychological expert be attached to every criminal court, so that, whenever necessary, psychological tests can be applied to determine the mental peculiarities of a witness. Such an examination might not be necessary for every witness, especially when his testimony is of a routine sort and has no critical bearing upon the case. But when the testimony is about a complicated and critical situation, when contradictions arise, or when it is suspected that the witness is lying or withholding information, such examination is expedient. Samples will be given of the normal limitations of mental reactions and of the kinds of individual differences that may be expected in the functions commonly exercised in legal procedure, when the individual is doing his best to reproduce the facts of his experience. A good general impression of the reality of individual differences may be obtained from the statement of Binet to the effect that, of the descriptions given by 150 people of a simple picture, no two were alike. As the picture was being observed during the descriptions, all question of memory differences is eliminated. It is evident, therefore, that no two persons saw and interpreted this simple scene in the same way.

LIMITATIONS OF SENSATION AND PERCEPTION

Errors in report may arise from the limitations and distortions of the original experience because of the nature of the sensory apparatus. For instance, in the case of hearing it is extremely difficult to identify sounds as of a certain character and often impossible to assign them to their cause. A common demonstration experiment in the psychological laboratory consists in making a sound, as by tearing a piece of paper behind a screen, and asking the hearers to describe what they heard. A most surprising variety of replies is invariably received, showing a great distortion and exaggeration of the experience. The following incident cited by

William James^a from his own experience will illustrate the distortion of auditory events by a normal person. "Sitting reading late one night, I suddenly heard a most formidable noise proceeding from the upper part of the house, which it seemed to fill. It ceased, and in a moment renewed itself. I went into the hall to listen, but it came no more. Resuming my seat in the room, however, there it was again, low, mighty, alarming, like a rising flood, or the *avant-courier* of an awful gale. It came from all space. Quite startled, I again went into the hall, but it had already ceased once more. On returning a second time to the room, I discovered that it was nothing but the breathing of a little Scotch terrier which lay asleep on the floor."

The direction from which sounds come is subject to as much misinterpretation as their quality and intensity. The mechanism for direction finding, involving the two ears, is such that it is impossible by sound alone to determine whether it comes from above, below, in front or behind as long as the real source of the sound is equidistant from the two ears. Sounds that come from points *almost* equidistant from the two ears are subject to great errors of localization. Important consequences frequently depend upon the testimony concerning the character and direction of pistol shots, cries, splashes, thuds, crashes and the like.

Distortions of experience in normal vision are even more common than those of hearing. Colors are particularly difficult to identify correctly especially in weak light or in a slightly colored general illumination. Any one who has attempted to purchase a necktie or other colored article in dull daylight or artificial light, or to match colors under such circumstances is familiar with these phenomena. If the intensity of general illumination is gradually reduced, the quality of colors will change, so that red turns dark or

^a W. James, *Principles of Psychology* (Henry Holt and Co., New York, 1908), Vol. II, p. 100.

becomes black, while blues and greens may be correctly seen. With greater reduction of light, orange turns black, and finally the blues disappear. The size and distance of objects seen in dim light or in a fog are especially liable to serious distortion because the criteria upon which such perceptions depend break down under these circumstances. Witnesses frequently give conflicting testimony concerning the color tint of the smoke created by an exploding bomb, which would reveal the nature of the explosive substance, the color of a hat or other garment, the distance between two objects or persons, and they report fine details of objects seen in a dim light, that would be beyond the capacity of vision under the circumstances.

By means of the skin senses, and without the aid of vision, it is often impossible to distinguish between contact with a cold object and a wet object, or between brief contact with a hot object and a cold object. The other senses suffer similar significant limitations. Further, sensory limitations peculiar to the individual must be noted, such as color blindness or color weakness, poor visual acuity, poor hearing, poor sense of direction, in order that testimony may be given its due weight.

ERRORS OF JUDGMENT

Judgments and estimates growing out of perceptual experience, which are frequently called for in legal procedure, not only are subject to the errors peculiar to perception but undergo further distortion in the process of interpretation. The speed of moving vehicles and other objects, the number of persons in a group at a given moment, the amount of time elapsing between two events, have been judged and the amount and the nature of the error that is to be expected have been calculated. An experiment ⁴ on the judgment of

⁴F. E. Richardson, "Estimations of Speeds of Automobiles, *Psychological Bulletin*. Vol. XIII (1916), p. 72 (brief abstract).

the speed of automobiles is interesting because of the frequency with which the speed at which a car was traveling forms an important bit of evidence in cases involving serious accidents. Twenty-nine judges estimated the speed at which automobiles and motorcycles passed a given point. The cars ranged in character from a powerful eight-cylinder to a small four-cylinder car, and the carefully controlled rates of speed varied from six to sixty-eight miles an hour. Although the detailed data are not presented, the investigator concludes that "the estimations show marked irregularity and variability depending upon the size of the car, its noisiness, the rate at which it passed, the contrast of that rate with the one just previous, and the amount and kind of experience which the observer used as a basis of comparison. At high rates of speed, the observers were biased by their estimations of the probable maximum rate for such a car, resulting in marked underestimations. Estimations *en route* by automobile drivers and passengers have been collected which reveal an even more complicated judgment. Visual, auditory, cutaneous, kinaesthetic and organic impressions seem to contribute to such judgments."

This experiment, performed under circumstances most favorable for reliable judgment, in that the observers were under instructions and did their best to judge accurately, demonstrates the variability and inaccuracy to be expected under ordinary traffic conditions, where the attention is not directed to the need for judgment. Münsterberg⁵ obtained judgments of the speed at which a hand was moving around a dial. It actually moved about four inches per second. The estimates were to be made in any convenient terms. Following are some of them: man walking slowly, bicycle rider, trotting dog, electric car, express train, like a snail, seven miles an hour, fifteen miles an hour, forty miles an hour.

H. Münsterberg, *On the Witness Stand* (Clark, Boardman and Co., Ltd., New York, 1923), p. 23.

Such variation and distortion can only be accounted for by a lack of any fixed standard according to which speed may be estimated.

Estimates of number show errors of similar sort. When the number of spots on a card is estimated (the actual number being 50) the answers range from 25 to 200, with a very pronounced tendency on the part of most judges to greatly exaggerate the number. When the number is 20, the answers range from 10 to 70. Judgments of the number of persons in a college class, in a theater, in an athletic stadium, in a street crowd are subject to a like or greater distortion. More interesting even than the amount of the error is the apparent absence of all uniformity in the criteria of judgment from one observer to another. When such discrepancies as these can occur under experimental conditions, variations as large or larger may be expected in the testimony of witnesses.

Numerous laboratory studies show the nature of time estimation and the factors on which accuracy of estimation depends. Where there is a direct intention to estimate time intervals, the error is very great, and this increases when the judgment is retrospective, as in most cases of testimony. Axel⁶ has shown by carefully controlled experiments that, with adults acting as judges, the estimated duration of a twenty-second interval varies among individuals from 5 seconds to 100 seconds, and the estimated duration of a thirty-second interval varies from 5 seconds to 155 seconds. In addition to these individual differences, there are important sex and age differences. The matter is still further complicated by the fact that the character of the events occurring during the interval influences both the direction and the amount of the error of estimation. On the whole, the simpler and more routine activities induce overestima-

⁶ R. Axel, "Estimations of Time," *Archives of Psychology*, No. 74 (1924).

tion of time intervals, and the more complicated and varied activities lead to underestimation.

Boring⁷ required a group of 44 persons to estimate the time spent in showing a motion-picture scene. The actual time, which was one minute, was estimated to be from about 10 seconds to about 400 seconds. Time estimates of the most difficult sort are called for in court testimony, and the time intervening between a pistol shot and a cry, between such a shot and the appearance of a person at a given point, often a matter of a few seconds, may be of great consequence. Conflicting testimony is in such cases no necessary indication of intent to deceive, but is probably the outcome of simple errors of estimation.

THE FALLIBILITY OF MEMORY

The weakness of testimony due to the fallibility of memory has received most attention, probably because errors from this cause are the most obvious. Numerous laboratory experiments have been devised for measuring just what degree of fidelity of report can be expected under good circumstances. Descriptions of pictures from memory, in the form either of narrative or the answers to a series of questions, furnish a simple means of illustrating the discrepancy between fact and the memory of it. The experiment by Boring called for a report on a motion-picture scene lasting one minute. The observers were not told that they would be subjected to a memory test, but were instructed to pay careful attention to the picture. Immediately after the picture was shown, the observers dictated an account of all that they had seen. Then each one answered twenty questions based upon the picture. Table XLVII shows the average percentages of the total material that were reproduced both in the narrative

⁷E. G. Boring, "Capacity to Report upon Moving Pictures as Conditioned by Sex and Age," *Journal of the American Institute of Criminal Law and Criminology*, Vol. VI (1916), pp. 820 ff.

and questioning. As the experiment was intended primarily to discover sex and age differences, these groups are presented separately in the table. In addition to reporting the items remembered, each witness indicated those of which he was certain, and those he would be willing to swear were correct. The table shows: in the first column, the character of the witnesses; in the second column, the per cent of items recalled regardless of whether they were right or wrong; in the third column, the per cent reported correctly; in the fourth column, the per cent reported with certainty; in the fifth column, the per cent that were both certain and correct; in the sixth column, the per cent sworn to; and in the seventh column, the per cent that were sworn to and were correct. For our present purpose it will suffice to point out the relatively small size of all the figures. Under circumstances such that the maximum of attention is guaranteed and with report called for immediately after the event, the best group reported only 42.1 per cent of the facts, and of these only 32.6 per cent were correct. Only 32.5 per cent were reported by the poorest group, and of this amount only 20.1 per cent were correct.

TABLE. XLVII. THE FALLIBILITY OF REPORT

	PER CENT REPORTED		PER CENT CERTAIN		PER CENT ATTESTED	
	Total	Right	Total	Right	Total	Right
13 women	38.2	25.1	35.3	23.7	25.8	18.8
11 men	42.1	32.6	40.6	31.2	26.0	22.6
8 girls	32.5	20.1	30.0	19.2	17.5	13.4
12 boys	35.2	20.5	32.8	19.7	23.5	15.7

Legal testimony seldom rests upon experiences so favorable for correct remembrance as the events in this experiment. The immediate recall precludes all the weakening and dis-

tortion of the memory that occurs with the passage of time. The figures in Table XLVIII may be taken as typical of the influence of time interval when all the conditions are favorable for correct memory.⁸ It will be noticed that the accuracy decreases much more rapidly than the quantity of material reported, both in the narrative and in the deposition (questioning). The error increases more than 100 per cent in the case of the narrative in the course of 45 days. Such an interval is not a long one in legal affairs. The additional distortion that would be introduced through the frequent repetition of testimony before a coroner's jury, the grand jury, the trial jury, through the conferences with lawyers, and through the emotional excitement attending all these circumstances, can only be surmised.

TABLE XLVIII. INFLUENCE OF TIME-INTERVAL UPON MEMORY

	No. Recalled	Per-Cent Error	Questions Answered	Per Cent Error
Immediate	765	10.5	880	14.1
5 days	735	14.3	855	18.2
15 days	750	18.0	854	20.7
45 days	569	22.4	801	22.4

The conditions under which the original event was experienced have even greater influence upon the value of report than the memory changes during the interval between the event and the recall of it. Memories involved in testimony are almost always of the so-called incidental or unintentional sort. There is no definite intention to observe events and to remember them. Studies of incidental memory⁹ show that it is extremely weak and unreliable as con-

⁸ K. M. Dallenbach, "The Relation of Memory Error to Time Interval," *Psychological Review*, Vol. XX (1913), pp. 323 ff.

⁹ See G. C. Myers, "A Study of Incidental Memory," *Archives of Psychology*, No. 26 (1913); and S. M. Shellew, "Individual Differ-

trusted with "intentional" memory guaranteed by the nature of the usual "report" experiment. Events that are quite within the power of memory to reproduce, both in nature and quantity, are lost unless there is the definite intention to remember them.

All classes of facts that figure in evidence are affected, such as size and number of objects, their form and color and the passage of time. Achilles¹⁰ measured the difference between incidental and intentional memory for different kinds of material under experimental conditions that are far more favorable to good incidental memory than entirely uncontrolled experiences, and free from emotional disturbance and shock. Expressed in terms of the strength of intentional memory, the incidental memory for syllables was 81.3 per cent, and the association of names with photographs was 57.2 per cent. In the light of such studies it would seem to be a conservative estimate that all values for intentional memory in testimony should be reduced at least one half to indicate their incidental memory value. The few tests that have been made of naïve and unsuspecting observers support this estimate.

INFLUENCE OF SUGGESTION UPON THE QUALITY OF REPORT

It has long been known that the way in which a question is asked has an important influence on the actual correctness of the answers made to it. By various details of its construction, the question may convey implications, suggest replies or eliminate alternatives. In legal procedure the "leading question" has long been regarded as a possible source of fallacious testimony, but not until recently has there been an attempt to discriminate clearly the various

ences in Incidental Memory," *Archives of Psychology*, No. 64 (1923).

¹⁰ E. M. Achilles, "Experimental Studies in Recall and Recognition," *Archives of Psychology*, No. 44 (1920).

TABLE XLIX. THE INFLUENCE

	Times Asked	Percentage Right	Percentage Wrong
Did you see a —?	198	15	4
Did you see the —?	355	16	10
Didn't you see a —?	226	11	10
Didn't you see the —?	179	9	5
Was there a —?	325	32	18
Wasn't there a —?	341	31	24
Was the (k) m or n?	251	30	30
Was the (k) m?	355	32	34

types and degrees of leading questions from each other. Muscio's ¹¹ investigation may be referred to by way of illustration. Using motion pictures as material for observation, he asked questions, all of them of a leading character, and tried to measure the influence of different question forms upon the percentage of right answers, wrong answers and uncertain answers. These percentages, together with the number of times each question form was used, are given in the first four columns of Table XLIX. In the last six columns are the values of the questions in terms of caution, suggestiveness and reliability. Caution is indicated by the number of times a person reports that he "does not know"; suggestiveness by the number of times that the "lead" of the question was followed; and reliability is calculated by finding the percentage of the answers that are right.

The results were found to vary with a number of circumstances which cannot be considered here. The following conclusions were drawn: By using the definite article (the) instead of the indefinite (a) the suggestiveness, caution and reliability were all decreased. Introducing the negative

¹¹ B. Muscio, "The Influence of the Form of a Question," *British Journal of Psychology*, Vol. VIII (1916), pp. 351 ff.

OF LEADING QUESTIONS

Percentage Uncertain (Caution)	Order	Suggestive- ness	Order	RELIABILITY	
				Per Cent	Order
81	2	89.2	2	78.4	1
74	4	62.6	5	61.5	4
79	3	91.7	1	52.0	6
86	1	84.0	3	64.0	3
50	5	43.6	7	64.2	2
45	6	51.8	6	57.0	5
40	7	77.5	4	49.7	7
34	8	39.7	8	47.8	8

(not) into the question decreased caution and reliability and increased suggestiveness. By asking whether certain things were present or occurred, rather than whether they were seen or heard, suggestiveness, caution and reliability were all decreased. By asking concerning the presence or occurrence and also including the negative, suggestiveness and caution were decreased. Including both the definite article and the negative gave more complicated results. The so-called "implicative" question, "Was the (k) m?" was found to be "lower than all the other forms investigated, for suggestiveness, caution and reliability." The "incomplete disjunctive" form, "Was the (k) m or n?" was found to possess a "relatively high suggestiveness, a relatively low caution, and a relatively low reliability." In general and with certain qualifications the investigator concluded that the most reliable form of question was that which related to the actual seeing or hearing of an item, using neither the negative nor the definite article.

THE INFLUENCE OF OATH AND OTHER FACTORS UPON THE CHARACTER OF REPORT

An oath does not guarantee accuracy of report, but it does reduce both the number of items reported and the percentage

of error. The figures in Table XLVII (page 481), taken from the experiment of Boring, will serve as an illustration. In the case of men 42.1 per cent of the total items are reported while 32.6 per cent are right. Under the oath, the per cent of items reported falls to 26.0 per cent, but of these 22.6 per cent are right. That is, whereas 77.4 per cent of the items reported by the men are correct, 86.9 of those given under oath by the men are correct. The data assembled by Whipple¹² show that, although errors are reduced about half by the introduction of an oath, there still remains about 10 per cent of error in sworn testimony.

Other factors affecting fidelity of report, especially practice, have been examined by Breukink.¹³ He used three different pictures on occasions a week apart, with the same group of observers. The reports were always written, the first narrative being supplemented by a series of questions. He found that if the individual's report was divided into sections, the earlier parts were more reliable than the later parts, showing that the items first coming to mind were more likely to be correctly reported. Reliability also increased with practice, the third picture being more reliably reported than the second, and the second than the first. This increase was especially pronounced in the interrogatory and in the ability to resist suggestive questions. Practice also increased the reliability of oath. He found that his educated subjects mentioned two or three times as many items as the uneducated, and the practice effects were more conspicuous with the educated group than with the uneducated. The uneducated would take oath to two or three times as many answers to suggestive questions as would the educated. No consistent sex differences were found in fidelity of report,

¹² G. M. Whipple, *Manual of Mental and Physical Tests* (Warwick & York, Baltimore, 1915), Chap. 8.

¹³ H. Breukink, "Über die Erziehbarkeit der Aussage," *Zeitschrift für Angewandte Psychologie*, Vol. III (1909), pp. 32 ff.

except that the women were found to be more reliable than the men in their testimony concerning the colors of objects.

The accumulated literature in the field of testimony is so considerable that no brief summary can do justice to its range and practical suggestiveness. The chief problems for the immediate future lie in the correlation of these experimental results with the necessities of practical life and in the suitable adaptation of the methods and the various results of measurement to the requirements and purposes of court procedure.

INDIRECT INDICATORS OF EVIDENCE

In the accumulation of evidence, it is necessary not only to properly evaluate that which is given voluntarily and with all possible assistance from the witness, but to elicit it where there is unwillingness to coöperate or definite efforts to withhold information. The application of psychology to these problems is more spectacular but less important than the applications already considered. Many methods have been and still are in use for this purpose which have a good psychological foundation, although they can scarcely be called psychological methods. Among these is the method of exhaustion, by which the individual is kept awake and answering involved questions for many hours until his resistance and control finally break down and he tells all that he knows, and sometimes even more than he knows, just to get relief. The method of intimidation by which the individual is threatened with bodily harm if he does not tell the truth, and the use of sudden fright are sometimes resorted to. They are all similar in that they tend to break down the control which one normally exercises over his responses.

The strictly psychological methods make use of responses that, under ordinary circumstances, are not under the control of the individual, and which will, nevertheless, serve as indicators of knowledge. A number of such indicators have

been suggested and tried, among them the association reaction, the breathing, blood pressure and the psychogalvanic reaction. The first of these, the free association method, is the best known. It has come to be a favorite form of demonstration in many psychological laboratories, and in one of its forms is usually conducted in the following manner: Three members of the class are sent out of the room in charge of an assistant, who selects one of the three to play the rôle of "criminal" in the test. This person is put through some experience in which the two remaining students do not participate—is shown a picture, read a story, instructed to perform some more or less exciting act, etc. The three students are then brought into the classroom one at a time and are given the free association test. A list of words has been prepared which contains some that are simple and unrelated to the experience and some that are called "critical." These are the words that are closely related to the experience through which one of the three students has just passed. If, for example, the experience had consisted in the sight of a human skeleton standing in the corner of a dimly lighted room, part of the list of words might be as follows, where the critical words are underlined:

sweet	<u>skull</u>	chair	paper
<u>dark</u>	city	color	desk
grass	<u>bones</u>	<u>dead</u>	<u>ghost</u>

The list of words is read to the person one word at a time and he is required to reply quickly and with the first idea that comes into his mind. These association responses are recorded and in each case the time is measured which has elapsed between the response and the presentation of the stimulus word. The series is then gone through again, in reverse order, and the original reactions called for. In this manner all three of the students are examined and the in-

structor or the class judges, on the basis of the test results, which of the three "suspects" is guilty—which one possesses the special knowledge or experiences the special emotions produced by this knowledge.

The indications that the "guilty" individual will be likely to give in such an examination are:

1. Significant reactions to critical words.
2. Retarded reactions to critical words or to indifferent words following closely upon them.
3. Changed reactions to critical words when the reverse series is given.
4. Undue number of stereotyped or reverberating reactions.

The first indicator, the "significant reactions," may be expected because the ideas connected with the "crime" should be deeply impressed upon the mind and hence most ready to offer themselves as responses to the critical words. The second indicator, "retarded responses," results from the attempt to inhibit the incriminating responses and to select others in their places. The time consumed in doing this is easily measured with a stop watch. The fourth indicator, "stereotyped responses," is also the result of an attempt to choose among possible responses instead of giving the first and readiest one. The third indicator, "changed reactions," appears when the second set of responses is compared with the first. If a significant reaction is inhibited the first time, the emotional excitement will be likely to interfere with the memory of the response that is given, so that, upon a second presentation of the critical stimulus word, the significant one will again tend to come to mind. If this is inhibited, and the one just given cannot be recalled, a new response will have to be found. Such a changed reaction is not normal, for if the instructions are followed and the first idea that comes to mind is given, this will be the same in both cases.

When skillfully conducted, the experiment in this form

seldom fails. The procedure has been suggested as a means of indirectly securing evidence which the direct interrogatory, cross examination or "third degree" might fail to reveal, and the application of the method in police and court procedure has been enthusiastically advocated by some psychologists. The writer has seen the method used in the case of a suspected thief, whose guilt was not only satisfactorily demonstrated, but whose actions subsequent to the theft were also partially disclosed. Confronted with the evidence of the experimental results, the man confessed, and told a story of the crime which confirmed the indications of the experiment. The practical merits of the method and its ultimate possibilities are still open to discussion. It should, however, be noted that in the form here described the problem is only that of determining which of a number of individuals is guilty, whereas the practical problem, that of determining the guilt or innocence of a given individual, is a much more difficult matter.

Crane,¹⁴ who has made the most thorough laboratory test of the method, says in regard to its use in crime detection:

As to the possibility of such a practical use, results have been entirely negative. These results show clearly that it is possible to make much finer measurement of the lengthening of reaction times than has hitherto been made. But they show further, that even with this added refinement, the method cannot be depended upon as a means of determining guilty knowledge. With certain naïve types. . . it might work. However, the fact that the results pointed so conclusively in one case to the guilt of an absolutely innocent test person, while in the case of the one person who entered most thoroughly into the spirit of the test, no positive evidence was obtained, makes it impossible, on the basis of our present knowledge, to depend upon this test.

¹⁴H. W. Crane, "A Study in Association Reaction and Reaction Time," *Psychological Monographs* (1915), No. 80, pp. 61 ff.; see also H. Münsterberg, *On the Witness Stand* (Clark, Boardman and Co., Ltd., New York, 1923), pp. 71 ff.

Marston¹⁵ used a somewhat modified technique to determine the effect upon speed of association reaction of the attempt to lie, as contrasted with telling the truth. He found three types of persons in his group: the positive type, whose time is lengthened and made more irregular; the negative type, whose time is shortened; and a mixed type, in which the individuals fluctuated between shorter and longer reactions when attempting to lie. The persons in the first group reported a mental state of fear, confusion and distraction, while those in the second group reported a certain tendency to distraction but an ability to overcome it. The practical application of the method is made difficult by these type differences, although the experimenter, after classifying his subjects, succeeded in judging deception correctly in 75 per cent of the cases.

"In any event, if psychological authority can succeed generally in disabusing the minds of the average jury of the conviction that the slightest hesitation, delay, or confusion in the testimony of any witness is indicative of deception, or that rapid and clever answers in cross-examination are indubitable earmarks of a white conscience, a constructive development in the weighing of evidence should be effected in an innumerable number of trial cases."

The other methods, known collectively in the laboratory as the method of expression, proceed on the assumption that emotions are attended by characteristic motor reactions, among which are included gross external muscular innervations, changes in respiration and heart beat, vascular adaptations and changes in the secretion of various glands, such as the salivary and the sweat glands. By the use of appropriate recording apparatus, sphygmographs, pneumographs and galvanometers, the organic changes which occur during such an examination as that of the preceding experiment may be

¹⁵ W. M. Marston, "Reaction Time Symptoms of Deception," *Journal of Experimental Psychology*, Vol. III (1920), pp. 72 ff.

registered, and these may offer significant suggestions. Thus, Benussi¹⁶ reports that the truth or falsity of an oral statement can be detected by noting the ratio of length of inhalation of the breath to length of exhalation before and after the statement. The fraction, inspiration divided by expiration, tends to be larger immediately after a lie has been told than immediately before, when it is being planned, while the reverse is the case when the truth is being told. What is probably indicated is the greater concentration of attention and general tension required to lie successfully, with a sudden relief of tension as soon as the lie is told. It is likely that an increased tension from any cause whatever would produce similar breathing changes.

Interest has been directed in recent years to changes in blood pressure as an indicator of deception. Systolic blood pressure is raised by emotions of fear and anger, which are believed by Marston to constitute "largely" the deceptive consciousness. This investigator, testing out the blood pressure method for the National Research Council, reports 100 per cent success in discovering deception.¹⁷

The method of expression for the discovery of deception has been employed on the most elaborate scale by Larson.¹⁸ He obtains a continuous record of blood pressure and breathing before, during and after a series of questions or association words pertaining to a critical situation. Deception is indicated by a rise in blood pressure and a dis-

¹⁶ V. Benussi, "Die Atmungssymptome der Lüge," *Archiv für die gesamte Psychologie*, Vol. XXXI (1914), p. 244; see also H. E. Burt, "The Inspiration-Expiration Ratio during Truth and Falsehood," *Journal of Experimental Psychology*, Vol. IV (1921), pp. 1 ff.

¹⁷ W. M. Marston, "Psychological Possibilities in the Deception Tests," *Journal of Criminal Law and Criminology*, Vol. XI (1921), pp. 551 ff. For a legal opinion concerning the use of this method, see *Washington Law Reporter*, Jan. 4, 1924.

¹⁸ J. A. Larson, "The Cardio-pneumo-psychogram in Deception," *Journal of Experimental Psychology*, Vol. VI (1923), pp. 420 ff.

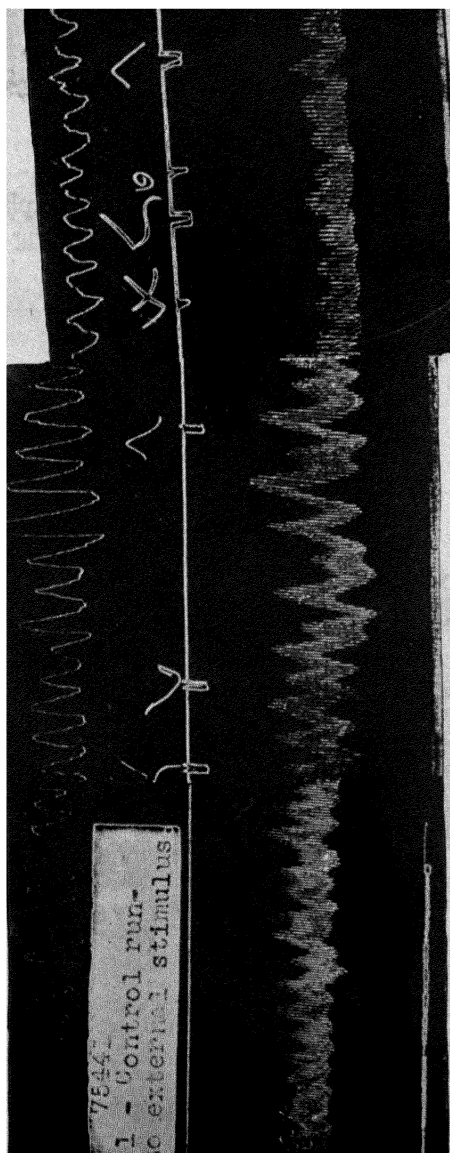


FIG. 45. CHRONOGRAPHIC RECORD OF BREATHING AND BLOOD PRESSURE CHANGES UNDER EXAMINATION

Would You Cheat at Solitaire?

"He is the sort of person who would cheat at solitaire. How often have you heard this expression and chuckled over it? The idea of cheating one's self is so ridiculous.

Yet in the far greater game of life which, for the most part, you are forced to play alone, you may be constantly cheating your self.

Every time you neglect to keep yourself in the best of physical condition every time you ignore the common sense rules of health by that much do you decrease your chance to win the stakes of success and happiness. And if you continue to violate the rules you are apt to find yourself a hopeless loser long before the game is over.

In so far as your health is concerned, the Life Extension Institute can help you play the game of life. By thorough periodic physical examinations it can help you avoid disease. By acquainting you with the simple laws of right living, it can help improve your health and prolong your life.

The Life Extension Institute was the prototype encouraging health examinations. It was founded in 1913 by Harold A. Ley and Professor Irving Fisher of Yale. Former President William H. Taft, Major General William C. Corgas, Robert W. de Forest, Alexander Graham Bell, Charles H. Nelson and many nationally known physicians, scientists, educators and public health workers were enlisted in the cause. Ex-President Taft served as Chairman of the Board of Directors of the Institute from the time of its organization until his appointment as Chief Justice of the United States Supreme Court.

In nearly one half a million people examined during the past thirteen years, close to two million defects were found that could shorten life and lower vitality. More than 60% of these defects were preventable or curable. Because of this broad

experience, the Institute has developed highly efficient methods of detecting and interpreting important impairments which most people do not know they possess.

The services of the Institute include a thorough examination of the whole body, periodic urine analyses, extensive reports, suggestions as to any needed medical treatment, instruction in all phases of correct hygiene, including diet, exercise, work, rest, play and the proper care of the mind and body.

The Institute has reason to believe that fifteen to twenty years can be added to the average life and a vast amount of sickness and suffering prevented, by following out the system which it advocates. No medical treatment is given by the Institute. All examinations are absolutely confidential.

The Institute has about 900 examiners in the leading towns and cities of the United States and Canada, all physicians of unquestioned standing in their profession. Those who find it inconvenient to come to the New York, Boston or Chicago offices can be examined in their own locality. The Institute's standard forms are used wherever examinations are given.

Why risk going through life just half living and half succeeding, robbed of the personal magnetism and physical vigor that are yours as long as you safeguard your health? Why not play fairly and squarely with yourself? A thorough physical examination is the first step.

Write, telephone or visit the Institute for further information about its health services and instructions on healthful living, and ask for a copy of "How to Live Long," and the "Keep Well" booklet illustrated. The coupon below is for your convenience in securing further information without cost or obligation.

The 16 Rules of Health

Copy these rules and follow them and you will be on the way to a long and healthy life.

1. Visit your doctor every year.
2. Visit your dentist every year.
3. Wash your hands and face often.
4. Sleep at least 7 hours a night.
5. Avoid excess of high protein foods, such as meat, fish, eggs, etc. Eat a lot of fruits and vegetables.
6. Eat a lot of hard water.
7. Eat at regular intervals.
8. Use moderate exercise and rest.
9. Breathe through the nose at all times.
10. Do not sit and walk erect.
11. Do not allow persons and objects to enter the body.
12. Keep the teeth, gums and tongue clean.
13. Work, play and sleep in moderation.
14. Breathe deeply, take deep-breathing exercises several times a day.
15. Keep awake and wide awake.

Most important of all is the practice of getting yourself thoroughly examined at regular intervals.



LIFE EXTENSION INSTITUTE

3 West 42nd Street, New York

Please send me five of the coupons, the booklet "How to Live Long" and the "Keep Well" booklet printed above, also complete information about the services of Life Extension Institute.

Name

Address

City

State

FIG. 46. HOW PREVENTION OF DISEASE IS BEING SOLD

turbance of breathing. Thus, the record reproduced in Figure 45 was obtained during the examination of an individual who was suspected of having taken a twenty-dollar bill. Three records are included on the chart, the upper one a breathing curve, the next one a time signal line showing when the different questions were asked, and the lowest one a continuous blood pressure curve. The first third of the chart indicates the control or rest period when no questions were asked. At the point marked "5" the question, "Do you like to dance?" was asked. At "6" the question, "Did you take a twenty-dollar bill from the house?" was asked. At this point the breathing becomes disturbed and the blood pressure rises. The last third of the chart shows the reactions to the same questions after a confession was obtained and indicates that there is no longer any disturbance of mind. The blood pressure, therefore, is said to vary under four sets of circumstances, at rest but before confession, during non-significant questions before confession, during significant questions before confession, and after confession when questions cause no change.

In the case of what has come to be known as the psychogalvanic reflex, changes in the secretion of the sweat glands incident to the arousal of an emotion may be indirectly observed through the use of the galvanometer. But up to the present time this method has been able only to indicate that some emotion or excitement is present. The character of the emotion, its basis and deep-seated significance, cannot be inferred from the records. There is no way of distinguishing at present between excitement or tension caused by guilt as contrasted with that caused by suspicion of guilt in the innocent.

As for all these methods of securing indirect evidence, whether or not they may constitute a genuine contribution to legal and criminal procedure remains for their future elaboration and application to determine. Their present status may

be inferred from the following quotation from the work of Marston, referred to on page 492.

The future of all deception tests lies in the possibility of their introduction as a basis for expert testimony, just as the various neuropsychiatric tests are now used as the basis for testimony by alienists in cases of alleged insanity. . . . The court must be convinced that a sufficiently sound and fundamentally scientific knowledge of all the psychological symptoms of deception are available to enable the alleged expert, not only to give his opinion to the jury, but also to answer hypothetical questions put to him under cross examination, showing upon what state of psychophysiological fact said opinion has been based. . . . Thus, it is extremely doubtful whether a single deception test, such as the association reaction time, the Benussi breathing test, or the systolic blood pressure test, would be admitted as a basis for expert testimony in court without a broader foundation of psychological fact than is at present available.

CHAPTER XXV

PSYCHOLOGY AND THE LAW: III. TREATMENT OF THE OFFENDER

THE problems of crime prevention discussed in an earlier chapter are very closely related to the problems of punishment and other forms of treatment of the offender, for in modern times, in intention if not in practice, all such methods aim at prevention of further crime and the protection of society from criminal acts. The immediate outcome of a psychological attitude toward the treatment of offenders will be the elimination of all notions of retribution which still show a firm hold upon many forms of so-called corrective measures. Furthermore, the individualization of corrective measures according to the needs of the offender will keep pace with the process of individualization in business, industry, education and in the field of management. In so far as the criminal is found to be intellectually deficient, the corrective, remedial or protective social measures must be adapted to the degree of the defect. If the deficiency is so severe as to make adaptations to a simplified social environment impossible, he should be removed from social situations, and prevented from the propagation of his kind. Certainly, capital punishment, torture, prolonged solitary confinement, hard labor, moral suasion and educational efforts will not change the mental status and the irresponsibility of such defectives. The experiences of the Vineland Training School for Mental Defectives and other similar institutions in their attempts to educate defectives offer sufficient proof of these statements. Where the deficiency is less marked, some form

of periodical supervision and some means of guaranteeing sufficiently simple social contacts may be adequate. Where the crime is merely evidence of mental illness or some organic degeneration, the individual is entitled to just as careful and competent treatment as a patient suffering from any less dangerous malady.

For the cases that do not fall within these categories, some form of punishment is generally advocated, which shall serve as a deterrent from further crime on the part of the individual, as a means of educating him for more adequate adjustments to life, as an example to deter others from similar acts, and as a temporary protection to society during the regenerative process. It will be generally recognized that modern punishment methods fall far short of accomplishing all these ends. That function of punishment which is by far the simplest, namely, to deter from further crime, has been and still is the object of active controversy. Does punishment act as a deterrent, and if so, what forms of punishment will be most effective in this respect? These and many other problems of punishment may be approached from the psychological point of view, although the psychological laboratory has relatively little ready-made data to offer.

DETERRENT EFFECTS OF PUNISHMENT

The important position occupied by the deterrent value of punishment in the modern conception of crime is indicated in the following definition: "A crime is an act which is adjudged by lawful authority to be so deleterious to the public good as to require it not only to be prohibited, but to require the punishment of those who disobey the prohibition, to the end that, an example having been made, the prohibition will be obeyed."¹

¹ C. C. Nott, "Coddling Criminals," *Scribner's Magazine*, Vol. LXXIX (May, 1926), p. 540.

There is a certain psychological justification for punishment as a device for correcting and regulating behavior. In the training of both animals and children punishment for wrong doing has its place as a companion to reward for correct action. Prominent among the laws of learning is the Law of Effect, that the individual tends to learn quickly and to repeat those reactions which are accompanied or followed by a satisfying state of affairs, and to avoid repeating and to escape from those reactions which are accompanied or followed by an annoying state of affairs. There are three vital rules that must be obeyed to make punishment effective as a corrective device, which in the present-day methods of criminal procedure are especially difficult to apply. They are (1) that the punishment should follow *invariably* the wrong action; (2) that the punishment should occur immediately or very soon after the wrong action; and (3) that the punishment should be so annoying or painful that it will be more desirable to follow the right than the wrong course of action.

In practice all three rules are violated. The punishment not only does not follow invariably but the chances of escaping punishment altogether are rather great. This condition is due both to the difficulty of detecting the offender and the difficulty of getting a conviction after detection. Modern inventions such as the automobile, the gun silencer, the electric metal burning torch and high explosives not only render useful service to mankind but offer effective means for the commission of crime and lessen the chances of discovery. The technicalities of the law, originally created for the protection of the innocent, have become, in the hands of unscrupulous lawyers, the means by which the criminal may escape conviction. There seems to be a general understanding among criminals that a delay in the trial of their cases means an advantage to them. The Department of Public Welfare of Georgia found in 1924 that of 100 cases disposed

of within 90 days of filing, 78 per cent were convicted; of 100 cases disposed of within 91 to 270 days, 43 per cent were convicted; and of 100 cases disposed of after 270 days, only 34 per cent were convicted. The average time elapsing between arrest and final disposition of the case in the Common Pleas court in Cleveland was found to be 69.3 days.

Where conviction is finally obtained, the punishment follows so tardily upon the crime that the deterrent effect is slight upon others than the criminal, and probably also upon him. Both these evils, uncertainty and delay, and some of their causes, are indicated in the following paragraph which describes the diverse agencies responsible for detection, trial, conviction and punishment of an offender. They have been recognized as factors contributing to increase in crime and steps have been taken especially to speed up the legal machinery in the handling of criminal cases.

The Police Department may arrest a criminal, or it may fail to catch him. It may prepare and present the evidence properly, or it may fail to do so. If the Police Department does not catch the criminal, of course the matter ends. If the Police Department catches the criminal and properly presents the evidence before the Police Court, the Police Judge, or City Judge, binds him over to the Grand Jury. If the City Judge binds over to the Grand Jury, then the Grand Jury may indict or return a not true bill. If the Grand Jury fails to return an indictment, that usually ends the case, and two members of the Grand Jury can prevent an indictment. If the Grand Jury indicts, the Prosecuting Attorney usually reviews the evidence and the facts, and sometimes nolle prosses the indictment. If he recommends such procedure, that usually ends the case. If the case goes to trial in the Criminal Court, a jury of twelve men must first be selected, with the attendant delays, if it be a case of major importance. After our best citizens have either disqualified themselves, or been disqualified by reason of our antiquated jury system, the trial is had in the Criminal Court, and one man out of twelve on the jury can cause a mistrial bringing about the usual delay, scattering of witnesses, etc., all of which operates for the benefit

of the criminal. Attorneys for the defense interpose all manner of objections in the effort to get the court in error. If the jury finds the defendant not guilty, that, of course, absolutely ends the case. If a mistrial is had, then on a second trial, it is even more difficult to obtain a conviction. If, however, the defendant is found guilty, and, as is the case usually in this county, a minimum sentence is imposed, it goes to the Supreme Court for review. It there passes completely out of the hands of local officials and the State Attorney General presents the case before the Supreme Court, examines the record, and, if errors of procedure appear, the case will be returned for a new trial in the local criminal court with its attendant delays and disadvantages. If, however, the Supreme Court affirms the decision of the usual minimum penalty, the convicted person immediately starts about to get a pardon. His family and friends bring all pressure to bear upon the Governor and the Pardon Board, and if the criminal is pardoned, of course the whole procedure goes for naught.²

The deterrent effect of punishment must rest primarily upon the *anticipation* of dissatisfaction, annoyance, discomfort or pain as a consequence of the forbidden action. The failure clearly to understand the intended purpose of punishment, the confusion of its deterrent function with that of reëducation, or possibly the hope that a given punishment might accomplish both ends, has led to a curious state of affairs. It seems obvious, when the problem is analyzed from the psychological point of view, that a form of treatment whose anticipation will act as a deterrent will not be a form of treatment best adapted for the process of reëducation. Yet the general trend of punishment methods has been away from severity toward leniency, without at the same time raising their reëducational efficiency. Along with the indeterminate sentence, there has gone a tendency to expect the minimum sentence, which may be further reduced for good behavior, service, etc. The prison methods, too, have, in

² R. Paine, "Crime Prevention," Report of Department of Health, City of Memphis.

many institutions, been radically changed. Work is done under conditions that compare favorably with those outside prison walls. Recreations are frequently available in a form and to a degree not enjoyed by free men. Facts such as these are dramatically presented in the following paragraph: *

In a recent number of the prison magazine at Sing Sing, I observed that during the baseball season just ended the local nine had played over one hundred games with outside visiting nines, viewed by the prison inmates from a concrete grandstand; that during the theatrical season there had been a theatrical performance nearly every Friday evening by various companies, many presenting the best shows running in New York, to see which the unconvicted citizen has to pay five or six dollars a seat; and the movies while away the tedium of almost all of the other nights of the week. The hours of work are much shorter than those of the ordinary working man; and until very recently, if the fastidious palate of any prisoner were offended by the prison fare, he was allowed, if possessed of the price, to buy special food for himself and have it specially cooked and privately served. In the prison at Great Meadow the inmates go forth at a gentlemanly hour in the morning (compared with the ordinary farmhand) to labor unguarded on the farm until an hour not too late unduly to fatigue them, when they return each to a large and commodious cell with a shower in it, where they refresh themselves for the evening meal and the evening entertainment. A few have strolled off and never returned, but the management should not feel mortified over its failure to please—there are always, everywhere, some hypercritical individuals who are never satisfied.

The views thus far expressed are not intended as an argument against the newer and more humane prison methods. They are not intended to prove that punishment should be used for its deterrent effect. But if punishment is to be used solely or primarily as a deterrent, then the tendencies toward greater leniency in dealing with prisoners in all respects are psychologically unsound.

* C. C. Nott, "Coddling Criminals," *Scribner's Magazine*, Vol. LXXIX (1926), p. 540.

LABORATORY STUDIES OF PUNISHMENT

Just exactly what conditions would be most deterrent could be discovered by properly controlled surveys, although reliable data would be difficult to secure. Two points are clear: first, that it may not be entirely safe to state *a priori* just what the most effective treatment of offenders would be; and second, that individual differences would appear here as in every case where human behavior is studied. A few years ago, an investigation was conducted, among the occupants of the death house of a large prison, concerning preference for various kinds of punishment. There was a general condemnation of the death penalty as a punishment device, a result not unexpected under the circumstances. Some, however, considered it preferable to 20 years or more of solitary confinement, as they thought the latter worse than death. The following experiment,⁴ whose results are only tentative even for the circumstances studied, suggests the possibility of submitting to experimental inquiry a variety of problems which are usually approached only through vague interpretation of ambiguous historical material or through biased judgment based on incidental and uncontrolled individual opinion. The instructions given to each of 50 persons (25 men and 25 women) who took part in the experiment were:

Imagine yourself to be on the point of committing some act which is socially and legally regarded as a crime, but which you are determined to perform because of the intense personal satisfaction it will bring you. The only deterrents are the chance of detection and conviction, the magnitude of punishment, and the social stigma incurred.

Assume that the penalty in all the different states is a period of imprisonment, which is, however, considerably different in amount in the different states, and that some states are more or

⁴H. L. Hollingworth (not published elsewhere).

less lax in their prosecution of the given offense, while others are exceedingly stringent in their methods of detection and conviction.

Suppose that the nature of the crime permits its commission in any one of these several states, with equal ease and facility so far as you are concerned. Which of these states would you choose first as the place in which you would commit the crime? If you could not select this state, for unavoidable reason, which would be your next choice? Place the ten states in an order of merit on this basis—placing first the one you would select first, second the one you would next choose, and so on, until the state in which you would be least likely to commit the crime is at the bottom of the list.

Kansas—Imprisonment for life. Almost absolute certainty of escape. Only 10 cases out of every 1,000 are detected and convicted.

Idaho—16 years imprisonment. Chances enormously in favor of escape. Only 30 cases out of every 1,000 are detected and convicted.

Montana—8 years imprisonment. Chances of escape very high. Only 60 cases out of every 1,000 are detected and convicted.

Wyoming—4 years imprisonment. Abundant chances of escape. Only 120 out of 1,000 cases are detected and convicted.

Arizona—2 years imprisonment. Considerable chance of escape. Only 250 out of every 1,000 cases are detected and convicted.

Utah—1 year imprisonment. Chances of escape and punishment are even. 500 out of every 1,000 cases are detected and convicted.

Colorado—6 months imprisonment. Fair possibilities of escape. 660 out of every 1,000 cases are detected and convicted.

Oregon—3 months imprisonment. Slight possibility of escape. 750 out of every 1,000 cases are detected and convicted.

Nevada—1 month imprisonment. Bare possibility of escape. 900 out of every 1,000 cases are detected and convicted.

Arkansas—10 days imprisonment. Absolute certainty of punishment. Not a single case escapes detection and conviction.

It will have been observed that in a general way the certainty of conviction increases as the magnitude of the penalty decreases. The reader should perform the experiment, making his own arrangement of the various alternatives and recording them, before reading further.

TABLE L. DETERRENT EFFECTS OF CERTAINTY AND MAGNITUDE OF PENALTY

Penalty	DISTRIBUTION OF JUDGMENTS									
	1	2	3	4	5	6	7	8	9	10
10 days										
1,000 certain	16	2	6	6	18	14	4	4	12	18
1 month										
900 certain	8	26	4	8	4	8	6	10	24	2
3 months										
750 certain	2	6	30	10	6	10	6	26	2	2
6 months										
660 certain	8	14	10	22	16	0	28	2	0	0
1 year										
500 certain	10	8	10	14	24	28	2	2	2	0
2 years										
250 certain	8	4	12	8	32	28	0	0	2	6
4 years										
120 certain	6	12	4	24	8	6	32	4	4	0
8 years										
60 certain	8	6	18	2	6	8	8	42	2	0
16 years										
30 certain	1	18	2	2	2	8	10	4	46	2
Life										
10 certain	16	4	2	4	2	4	2	2	6	58

Table L shows the way in which the various situations were evaluated. In the column on the left are given the various combinations of magnitude of penalty and certainty of conviction. Along the horizontal headline are indicated the various possible positions, ranging from 1 to 10. For a situation to be placed under 10 would mean that the particular combination represented was felt to constitute the strongest deterrent in the series, the strength of deterrence decreasing from 10 to 1. The figures in the various columns indicate the per cent of all the observers who placed the given situation at the point indicated. Thus, in the case of the one-year penalty, 10 per cent placed it in first place, 8 per cent in second place, 10 per cent in third, 14 per cent in fourth, 24

per cent in fifth, 28 per cent in sixth, 2 per cent each in seventh, eighth and ninth, and none in tenth.

In general these fifty people are seen to be made up of two different groups. The small penalties, with high certainties, tend to be placed more often either very high or very low. The larger the penalty and smaller the certainty the more the situation tends to be shifted toward the middle of the range, until the medium penalties (1 and 2 years) are reached. When this medium point is passed the lines divide again, and the larger numbers occur closer and closer to the extreme positions.

Now if the various situations were equally deterrent, we might have expected the same distribution of positions in all cases. If for all members of the group the larger penalties and the larger certainties were more deterrent we might have expected a single line, shifting from one extreme toward the center, then back again. If only penalty or only certainty were the crucial determinant, we might have expected one line of plurality choices, marching either one or the other way across the table.

But none of these results occurs. Instead, there is one group of people for whom the penalty is the determining factor and another for whom the certainty is the chief deterrent. For both groups the average penalties and average certainties have only average deterrent strength. One group is inclined to take the large chances of escape, risking the large penalty. The other group shows no inclination to gamble, preferring to accept the high probability of a small penalty. What individuals comprise these two groups the table does not show. The reader who may suggest that the men make up one group and the women the other is, however, in the wrong. The men and women react in the same way, and both show the division into two rather distinct groups, with small numbers of individuals occupying the gaps between.

If each time a situation is placed in 10th, 9th, 8th, 7th, etc., position it be credited with 10, 9, 8, 7, etc., points respectively, and the total points computed for each situation, the values shown in Table LI result. The larger the score the greater will be the deterrent effect on the total group of observers.

TABLE LI. ORDER OF DETERRENT VALUE OF PUNISHMENTS

Situation		Score	Order of Strength
10 days,	1,000 certain.....	292	3
1 month,	900 certain.....	265	5
3 months,	750 certain.....	261	6
6 months,	660 certain.....	223	10
1 year,	500 certain.....	224	9
2 years,	250 certain.....	244	8
4 years,	120 certain.....	253	7
8 years,	60 certain.....	285	4
16 years,	30 certain.....	331	2
Life,	10 certain.....	372	1

These results show that the extremes, either of penalty or of certainty, are judged to have the stronger deterrent effect on the group as a whole, the average degrees of each being relatively weak. Penalties of 8 years or more, even with high probabilities of escape, are definitely judged more deterrent than penalties of 3 months or less, with almost absolute certainty of conviction.

A somewhat similar experiment⁵ offering five choices to 200 men and women brought results resembling those just quoted. The alternatives to be arranged in order of preference were:

Judge A who always gives 1 year in jail but only 20 per cent are convicted.

⁵ J. S. Durham, *Certainty versus Severity of Punishment*, M. A. thesis (unpublished), Columbia University, 1925.

Judge B who always gives 6 months in jail but 40 per cent are convicted.

Judge C who always gives 3 months in jail, but 60 per cent are convicted.

Judge D who always gives one month in jail but 80 per cent are convicted.

Judge E who always gives 10 days in jail but 100 per cent are convicted.

Table LII, giving the results for the 200 persons, is to be interpreted in the same way as Table L, except that the least certainty is at the top of the table instead of at the bottom. Judge A, who offers the greatest chance of escape, is the favorite, although there is a fairly large number who prefer the lightest sentence with certainty of receiving it. Such differences as appear in the two experiments, doubtless, represent real variations among individuals in the willingness to take a chance or gamble, and show up equally in other life situations.

TABLE LII. CHOICE OF PUNISHMENT

	1	2	3	4	5
Judge A	49	13	6.5	11	20.5
Judge B	6	35	23	25	11
Judge C	2	14.5	56	19.5	8
Judge D	12.5	23	10.5	39	15
Judge E	30.5	16	5	2.5	46

In connection with the second experiment, it was intended to make a survey of prisoners' opinions, but the conditions were found to be such that the data obtained from them would probably be worthless. The numerous difficulties, complications, objections and sources of error that beset such inquiries in legal and criminal psychology are obvious. These need not be rehearsed here, although the inquiring student may well consider them, inasmuch as each raises to

consciousness a further problem, which might itself be investigated by some such procedure as that here followed. In this field, as in many others, the mere raising of problems to consciousness and their preliminary attack by methods however inadequate may constitute a significant contribution.

Opinions expressed by a number of heads of penal institutions were unanimous that a greater deterrent effect upon most offenders would be secured by increased certainty than by increased severity of punishment. The following by a chairman of a State Penal Code Commission will serve as a sample of them:

"I believe the greatest deterrent to crime is a quick trial and positive punishment, no matter what the amount of punishment would be. It is the one fact that criminals seem to know, that they can be arrested, enter bail, and have the date of their reckoning deferred indefinitely, which encourages them to continue in their evil ways. The certainty that one would be tried and punished immediately, no matter whether he entered bail or not, in my judgment, would help the cause of justice immensely."

REÉDUCATION OF THE CRIMINAL

Two facts about the treatment of offenders remain for consideration, namely, their reconstruction and the social defense against them. Decision must be made in every case as to whether reéducation is feasible. If it is, then the individual will need to be segregated only during the reconstruction process. If, however, it is not feasible, provision must be made for permanent segregation and the prevention of procreation. In the case of feeble-minded persons, who are at the same time vicious, and in the case of certain kinds of degenerates, permanent segregation seems to be the only proper course of treatment. The conception of treatment as a form of punishment should be eliminated, and methods of treatment should be chosen on the basis of such facts as

security, economy, comfort, etc. The failure to make an adequate diagnosis of criminal cases to determine which are and which are not reclaimable, has led to the failure of notable attempts to apply modern methods in criminology.

The problem of education is an extremely difficult one, even where it is feasible. In most instances, the persons are adults and, therefore, have passed the period when intellectual, social and moral habits are most easily inculcated. The difficulty is further increased because it is necessary not only to establish correct habits and correct attitudes toward social situations, but distorted ideas must be eradicated, antisocial attitudes must be corrected, and disrespect for law must be changed into respect for it. The greatest insight into human nature, skill in dealing with it and an unlimited amount of patience would seem to be necessary for those whose duty it is to educate the criminal. All these matters must be cared for while providing the individual with a means of earning an honest livelihood. Such facilities can scarcely be hoped for in an institution where the concept of punishment plays a dominant rôle. The prison system, where the more radical reforms have not touched it, represses the very natural tendencies which are ordinarily played upon in the educational process. Of first importance among these, perhaps, is the tendency toward social intercourse, which is reduced to the minimum in prison life. Such associations as do occur are among those who are likely to exert an evil rather than a beneficial influence. Added to this is the fact that most associations among the inmates of prisons must be carried on surreptitiously and at the risk of severe punishment. This tends to exaggerate the disrespect for authority and to foster a criminal cunning in outwitting it.

A psychologically sound system for the treatment of offenders may be suggested as a result of the preceding discussion. It would rest upon the conception of the individual as the unit to be dealt with. Each case should be analyzed

and classified on the basis of a study of immediate ancestry and personal history, including environment, education, character of associates, the nature of the offense, motives leading to it, etc. A twofold classification should be made into (1) those who cannot be reclaimed because of insanity, feeble-mindedness or too long a career of crime; and (2) those who can be reclaimed because of their youth, their intelligence and the nature of their offense. Insane hospitals, institutions for the feeble-minded and penitentiaries should be provided for those of the first group; industrial colonies and reform schools should be provided for those of the second group, with the adoption of the indeterminate sentence, parole or suspended sentence. For all cases there should be the maximum degree of certainty of detection that is possible to attain, together with the decision without delay of the treatment to be administered. A rigidity of discipline should be guaranteed that will be compatible with the progress of reforms and, while free from the atmosphere of punishment, still carry with it a deterrent value that cannot fail to be appreciated. Such a comprehensive plan is impossible to-day, because of the obstacles to an adequate analysis of the individual and because of the inadequacy of the machinery of the law and of the penal institutions. But the adoption of the point of view that a criminal is a psychological problem to be studied, and the recognition of how far the current systems of punishment fall short of such a point of view, are the first steps necessary to the gradual evolution of the penal system toward the ideal both for society and for the individual.

CHAPTER XXVI

PSYCHOLOGY AND MEDICINE: I. THE PREVENTION OF DISEASE

THE affiliation of psychology and medicine has always been especially close. Many of the older and best known psychologists had previously been physiologists and some of them had been physicians. Much psychological work, too, has been done by medical investigators. Evidence of this relationship in the early days of psychology as a science is to be found in Lotze's *Medicinische Psychologie*, and Tuke's *Dictionary of Psychological Medicine*. More recently, the books on abnormal psychology have been written primarily by medical men, such as Janet, Coriat, Sidis and Freud. On the other hand, numerous psychological methods have been taken over by medicine, and books on physiological problems, especially physiological psychology, have been written by psychologists. In France, there has been a common interest on the part of physicians and psychologists in abnormal mental phenomena. In the course of the specialization of training made inevitable by the expansion of the fields of psychology and medicine, there has developed a series of special vocations called psychopathology, medico-psychology, psychiatry and psychotherapy which lie midway between psychology and medicine. Men and women are being trained for such work and are being appointed to research and clinical positions in connection with many of the leading hospitals. All these facts indicate that psychology and medicine are, in part at least, joint tenants of a common ground of content and method.

ASSUMPTIONS UNDERLYING THE APPLICATION OF PSYCHOLOGY
TO MEDICINE

One of the most disputed questions of philosophy and a very vital one in the application of psychology to the problems of disease is that of the relation between the mind and the body. The common-sense theory, so-called because it seems to the layman to fit the facts best, is technically known as interaction. According to this conception, the mind and the body are separate entities, each being subject to the influence of the other. It is a matter of almost universal experience that a severe fright or a fit of anger will upset the digestion, and it is equally well known that a heavy meal eaten late at night will cause bad dreams or wakefulness. Instances of this sort could be furnished in great number to show that mental states affect the body and that bodily changes affect the mind. Such a physiological conception provides an excellent foundation for the great variety of theories of mental healing which range from the plausible to the absurd. There are, however, certain serious objections to this theory from the scientific point of view. That theory which is more commonly adopted in scientific work, but which leaves many things unexplained, is known as "psychophysical parallelism." It assumes that, whenever a certain mental act occurs, a certain physical act occurs, and vice versa, although neither one is the antecedent or cause of the other.¹

As a working hypothesis for psychotherapeutic methods, another point of view may be conveniently taken which is almost as plausible as the interaction theory, and more so than parallelism. According to this view, a stimulus will produce a composite reaction in the human organism, which may be

¹ A comprehensive treatment of these philosophical problems will be found in W. McDougall, *Body and Mind* (Methuen Co., London, 1918).

thought of as comprising both mental and physical reactions. There need be no question whether what occurred in the mind affected the body or what occurred in the body affected the mind. Sometimes there is very little in the reaction that can be called mental and sometimes there is much. An example will make this point of view clear. The perception of a lemon (mental response) after one has experienced the taste of lemons will cause a violent reaction of the salivary glands (physiological reaction). Other reflexes of the digestive mechanism are in the same way subject to such external stimulation. The cause of the salivary reaction is not the perception, but the cause of the perceptual reaction as well as the salivary reaction is the physical object, the lemon. Interest may be concentrated upon either aspect of the total response, and within limitations the one may be taken as the symptom of the other. But when it comes to diagnosis, treatment or prevention of disease, it is no longer adequate to play upon the symptoms either mental or physical, but it is necessary to get down to real causes producing both sorts of symptoms. A microörganism may cause both the changes in the pupillary reactions and the feelings of grandeur peculiar to general paralysis. A treatment which will reduce the physical symptoms will also reduce the mental symptoms, but only because it attacks the common cause of the two. We may take as a basis for psychotherapeutics, therefore, the view that the behavior of the organism or its parts can be influenced by stimuli applied by way of the special senses, as well as by way of the administration of medicines and the more common therapeutic devices.

THE PREVENTION OF DISEASE

There is a growing tendency in medicine, as in the law, to direct attention to preventive measures, to stimulate effort to "keep well" rather than to "get well." Just as in the law, this represents the culmination of a long history, in which

interest was first directed at treatment, and mainly treatment of symptoms. With the growth of scientific method, diagnosis began to take its place in medicine, and specialists in diagnosis flourished along with the specialists in treatment. The science of prevention had to wait necessarily for the growth of knowledge of causes, so that preventive measures could be intelligently applied. But the knowledge of causes is not alone sufficient to guarantee the success of preventive medicine. The preventive measures must be adopted by the individual and in most cases must be adopted voluntarily. The resistance that the proposal of methods of prevention meets, even among intelligent people, opens an interesting series of problems which psychology can help to solve. There are, indeed, two ways in which psychology may be applied to the problems of the prevention of disease: first, in overcoming the resistances to preventive measures in general; and second, in preventing those diseases which are peculiarly mental in character.

OVERCOMING RESISTANCE TO PREVENTIVE MEASURES

Preventive medicine for the individual, as conceived at present, would involve the institution of periodical medical examinations and the prescription, on the basis of these examinations, of such habits of living as will keep the human machine functioning normally. It recognizes the fact that most, if not all, diseases, especially the more insidious diseases, can be effectually dealt with if discovered at a sufficiently early stage of their development. The function of preventive medicine, then, is to see that the individual takes these necessary steps to insure health. Theoretically, there would seem to be no serious problem here. In every comprehensive list of native tendencies will be found one or a group called "self-preservation" or "self-protective" tendencies. They manifest themselves in such mechanical reactions as putting out the hands when falling, and in more compli-

cated ones leading to the relief of pain and discomfort. It is, however, a characteristic of such reactions that they are not far-seeing, but are rather reactions toward immediate relief. The case of the individual who goes to the dentist for the relief of the pain of a toothache will serve as an example. If, on the way, his attention is so diverted that the pain disappears, he may, if he is an average human being, return home because he is no longer in need of the services of the dentist. The protective reaction has ceased with the disappearance of the pain. Every general medical practitioner is familiar with cases of a similar sort. If, as a preliminary to the treatment of a serious and painful disease, something is done to relieve the pain, the patient may not return, even though the serious condition underlying the pain may have been fully explained to him. The immediate need for assistance has passed. In a state of nature such as that in which native tendencies probably developed, such reactions would be adequate for the preservation of the species. Now, however, preventive medicine implies a far-seeing reaction for the welfare of the individual.

It is not difficult to discover that the lack of an immediate emergency is the cause of lack of interest. Experimental health centers supported largely by private funds and calling for only a slight fee from the individual have failed, because the individual who is in good health sees no reason why he should pay even a small amount of money for the protection of himself or his family against the probability of sickness. The remoteness of the emergency offers the chief source of resistance against all life, health and accident insurance propositions. A useful aid in selling these commodities is frequently found by giving them an immediate force in the form of their value as an investment, their borrowing privileges, etc. A much more serious resistance, but of the same nature, is encountered in the sale of burial plots and the service of trust companies in the making of

wills and providing for the care of estates. Nothing is more inevitable than death and nothing is so uncertain as the tenure of life, and yet provisions against the emergency are notoriously neglected. "The atrocities of life become 'like a tale of little meaning though the words are strong'; we doubt if anything like *us* ever really was within the tiger's jaws, and conclude that the horrors we hear of are but a sort of painted tapestry for the chambers in which we lie so comfortable at peace with ourselves and with the world."

This indifference to remote eventualities is curiously complicated by another tendency which might seem to offset it, but which actually reënforces it, namely, the fear of disease and death. It induces a kind of negative attitude in which the person refuses to consider its possibilities. It is almost impossible to force the attention of a healthy person upon such topics for more than a moment. Generally speaking, this obliviscence of the disagreeable in one's past and a profound optimism for his future are desirable characteristics, although they do work to his disadvantage in special cases. Just as the resistance to making a will or buying a burial plot is compounded of an indifference to the remote and the unpleasantness of it, so the resistance to health protecting measures has in it something of the refusal to contemplate unpleasant events as well as indifference to them. It is not at all uncommon to find persons who will refuse to undergo a medical examination for fear it will disclose some disability, and who will say that, if anything is amiss, they prefer not to know about it. Less common, but not rare, are the cases where persons will actually and wilfully withhold information necessary for an adequate diagnosis in the course of an examination, which they have requested and for which they are paying a fee. It is amazing to the uninitiated how one can derive comfort from a diagnosis made false by his own deliberate deception. The skillful physician learns to detect such peculiar behavior and, by inspiring confidence in

his patient, to overcome it. The advertisement reproduced in Figure 46 strikes directly at these curious tendencies.

PREVENTION THROUGH EDUCATION

How may this indifference and fear be overcome? The same methods of education must be employed as are found effective for other purposes. The whole problem is largely a matter of salesmanship, in which disease-prevention is the commodity for sale. As it is a proposition of mass selling, advertising methods may be resorted to with advantage. The splendid publicity work of the Life Extension Institute and insurance companies, particularly the Metropolitan Life Insurance Company, in arousing interest in disease prevention, affords a good example of what may be done by applying modern selling methods to the dissemination of an idea. The following paragraphs are taken from an advertisement of the latter and show how parental affection may be appealed to in the promotion of preventive measures.

The business of being a parent is difficult at best. There are days when everything seems to go wrong—days when the children are so exasperating that you forget what they really mean to you.

But at night, when you steal quietly in for a last good-night look, how like blossoms they seem—exquisite promises of the future. You dream of the things you hope to do for them—of the advantages you wish to give them—of the gifts you would like to lavish upon them. But has it occurred to you that there is something else that perhaps you should be doing for them right now?

To-day—before it is too late—use the great gifts of modern medical science to protect your children from disease and to help them become strong and healthy men and women—physically, mentally and morally. Many deadly diseases can be prevented by vaccination or inoculation. Do not risk the blighting of a single blossom.

The aim should be, as far as possible, to arouse immediate and positive rather than negative and remote interests, such as

increased earning power, athletic build, healthful appearance, etc., rather than picturing what may happen at the age of sixty years. There is evidence of success from such educational methods not only in the statistics of the companies quoted, but in the increased preventive measures adopted in the care of the teeth and eyes. Periodic examination of these has come to be the rule among intelligent people. Advertising has had much to do with this. Periodic examinations of the body as a whole, however, are not so common among the well-to-do classes to whom most of the health advertising has been directed thus far, both by virtue of its general tone and the mediums in which it appears.

Where purely educational measures are not effective, force may be used to advantage. The fact that it is ever necessary to enforce regulations concerning the use of common drinking cups, common towels, and concerning quarantine against communicable diseases, shows the indifference of the public to the danger of contracting disease, and the need for drastic rules with penalties for their violation until the more subtle forms of education shall have accomplished their purpose.

There is one criticism sometimes offered against preventive medicine that deserves notice because of its psychological implications. That is the danger that attends the concentration of attention upon one's health, consequent upon a medical examination. Even in the most sophisticated persons, an examination creates some perturbation, and in highly suggestible persons it may initiate an introspective attitude and entail a long chain of imaginary complaints. It has been said that medical students, in the course of their training, suffer in imagination all the diseases whose symptoms they study. Ill effects of this nature resulting from periodic health examinations must be few and scarcely to be weighed against the greater benefits that will accrue from a widespread adoption of the practice.

In the broader health movements, such as the eugenics

movement for the prevention of inheritable diseases, as well as the projects of the Public Health Service for the elimination of certain diseases from large geographic areas, the psychological principles underlying education will play an important part. No measures of this nature can be successful without the acceptance of the idea, and its support by individuals. The annihilation of yellow fever required not only the drainage of large areas infested with the mosquito, but the education of the people to protect themselves adequately against the bites of those insects that survived. The same is true of malaria, bubonic plague and other scourges.

THE PREVENTION OF MENTAL DISTURBANCES

The function of psychology in the prevention of disease thus far discussed has been as an accessory to other agencies. It is concerned with the problem of gaining acceptance for a new idea, rather than with the discovery of the actual causes of disease or of the preventive measures to be introduced. It was shown that the acceptance of this new idea involves the breaking down of resistance offered by indifference and fear and the creation of new attitudes of foresight and provision for the future. Quite a different application of psychology and its methods is possible in the prevention of mental disabilities, by the discovery of their causes and the means of making them innocuous. Consideration will be confined to the prevention of the so-called functional disorders. Those with a definite origin in organic deterioration and other physical conditions are equally important but are outside the province of the present work.

Among the great variety of theories concerning causes of mental disorder, there stands out clearly as a common element the concept of the maladjustment of the individual to the conditions of life in which he happens to be.² The

²This concept of adjustment is set forth in F. L. Wells, *Mental Adjustments* (D. Appleton and Co., New York, 1917).

theories differ mainly in the causes that are offered to account for the maladjustment and the preventive means that are recommended. Three such causes may be briefly surveyed. The concept of heredity occupies a prominent place as a causal factor. The individual is born with certain inadequacies which definitely handicap him in the struggle for existence. The defects of intellect are best known and have contributed largely to the popularity of the hereditary concept, since it is easy to pass by analogy from this defect to the assumption of other forms of deficiency. The "low psychological tension" of Janet will serve as an illustration of a natural characteristic that would tend toward maladjustment. It is not necessary to assume that persons are born with insanities, neuroses or psychoses, but that their natural inadequacies become exaggerated and develop into them. On the other hand, they may remain mere deficiencies, if proper protective measures are adopted. "Everyone knows persons whose pessimistic temperament makes them inclined to an over-frequent depression, or others whose silly disposition brings out constantly those emotional tendencies which the maniac shows in an exaggerated degree. The stupid mind shows those lacks of association and connection which reach their maximum degree in the mind of the idiot. We know from daily life the timid, undecided man who cannot come to a will impulse; the hasty man who rushes toward decisions; the inattentive man who can never focus his consciousness; and the over-attentive man who can never dismiss any subject; the indifferent man on whom nothing produces evident impression and feeling; the over-sensitive man who reacts on slight impressions with exaggerated emotion; and yet every one of such and a thousand similar variations, needs only the projection on a larger scale to demonstrate a mental life which is self-destructive. The silly girl and the stupid boy, the man who has the blues and the reckless creature, are certainly worse equipped for the struggles of existence than

those who are intellectually and emotionally and volitionally well-balanced.”³ Here are displayed in miniature all the mental diseases. They are still within the realm of normality but circumstances that are too complicated, too rapidly changing or too difficult may distort them into disease.

The part played by the environment, both physical and social, as a causal factor in mental disease is evident in the hereditary interpretation. But it is frequently made to serve a more dominant rôle. Thus Patrick,⁴ in advocating the need for a gospel of relaxation, says: “It is very probable that our modern strenuous life is bringing too heavy a strain upon the brain, particularly those parts of the brain immediately connected with the mental powers which condition that peculiar kind of progress which the world is now making. The tendency of the times is toward a very swift industrial, commercial, professional, and intellectual activity. It is an age of great effort and endeavor, of stress and tension, of labor and strain, of scientific and inventive ability; an age of great efficiency and striving for efficiency; an age of variegation; a centrifugal age. It is not an age of peace and calm, of poise, of relaxation, of repose, of measure, of harmony, of conservation.”

The result of life under such conditions is a rapid and extreme fatigue of the nervous system and an insistent demand for rest and relaxation. But the organization of modern social life does not provide the natural means of attaining rest and relaxation, with the result that artificial means are resorted to, such as tobacco, alcohol and drugs. Such a combination of circumstances leads to a long train of mental ills in previously normal individuals.

The war offered a multitude of illustrations of the con-

³H. Münsterberg, *Psychotherapy* (Moffat, Yard and Co., New York, 1909), p. 77.

⁴G. T. W. Patrick, *The Psychology of Relaxation* (Houghton Mifflin Co., New York, 1916), p. 16.

sequences of unusual demands upon the individual. "Shell shock" and a great variety of psychoneurotic manifestations developed in persons who were capable of a normal life in times of peace, as a result of strain, worry, overwork and too sudden shifts in mode of life. It seems scarcely worth while to assume that such persons were potentially unstable, and thus to explain the cases as the result of hereditary tendencies.

A third view that has been proposed attributes the great increase in nervous and mental disorders not so much to the conditions of life which are recognized to be rapidly increasing in difficulty and complexity, but rather to a failure of our modern system of education to prepare youth to meet these conditions squarely. Münsterberg attacked particularly the principle of freedom in present educational methods and the dependence upon interest as a spur to activity, in that it does not furnish a sufficiently rigid discipline and train individuals to attack and conquer obstacles that they will inevitably meet. It is difficult, indeed, to evaluate such an interpretation. The fact of an increase in nervous and mental affections might even be questioned as the data available are not entirely unequivocal. Furthermore, the concept of freedom in education has been in force for too short a period to demonstrate its effects. More than one or two generations will be necessary to measure them adequately.

The preventive measures to be employed will differ somewhat according as emphasis is laid upon one or other of these causes. In few cases is it entirely impossible to prevent the onset of mental illness. Even in the case of inherited weakness, if the weakness be discovered, prophylactic measures may be employed. A favored and simplified environment, good food, exercise and properly regulated rest will do much to keep the poorly endowed person within the realm of normality. Where the inheritance amounts to feeble-mindedness, or equally grave deficiency, institutional care will be

necessary. In the case of an overcomplicated environment putting too much strain upon the human organism, the remedy is obvious, though difficult to provide in the case of any given individual, since the ill is primarily a social one. According to Patrick, environmental conditions should be simplified by the elimination of highly congested urban districts, now advocated also for economic and other reasons. In addition, opportunities should be available for rest and relaxation of a natural sort, as opposed to the highly artificial and emotionally stimulating recreations now so much in vogue. It was found possible to ward off the impending war neuroses in many cases without removing the person from his environment, by the application of intelligent instruction and the careful regulation of the routine of life. A similar treatment will meet with success in civil life.

Speedy adoption of the simplified living conditions that are frequently recommended is out of the question for the majority of people. A return to outdoor life, with more walking, horseback riding, hunting and fishing, the cultivation of the soil and the care of domestic animals, cannot easily be substituted for the automobile, the motion picture, the theater, dancing and the reading of novels. It would require the reorganization of modern social life. Any mental ills that can be attributed to educational methods will find ready correction. Changes in theory and practice occur frequently, and much of the present educational practice is patently experimental. That which is good will remain and the useless or the harmful will be disposed of. Of all the suggested causes of functional disorders the most stubborn will be found in the characteristics of our social institutions. If complications continue to multiply more rapidly than the human organism can adapt itself to them, the problems of prevention of disease will become more and more serious.⁵

⁵ An interesting prospect is presented in W. McDougall, *Is America Safe for Democracy?* (Charles Scribner's Sons, New York, 1921.)

CHAPTER XXVII

PSYCHOLOGY AND MEDICINE: II. THE DIAGNOSIS OF DISEASE

PSYCHOLOGICAL data and methods occupy an important place in the diagnosis of disease. In the organic and nervous diseases, many of the symptoms consist of sensory and other mental phenomena to be discovered by tapping the introspections of the patient, or by detecting them through psychological experiments. Then, too, in the functional mental disorders especially, the changes in mental experiences constitute the disease itself and these must be discovered and evaluated by psychological methods.

NEED FOR A KNOWLEDGE OF NORMAL BEHAVIOR

In the use of mental reactions, either as indirect symptoms of disease or as direct evidence of it, a thorough understanding of normal human behavior is a primary requisite. The physician prepares himself for the diagnosis of physical disease by a study of normal anatomy and physiology, followed by a study of pathology. That is, he studies the normal organic machine, how it works, and what it is like when it gets out of order. Much less attention, or in many cases no attention at all, is paid to the extremely significant mental factor in all diagnoses. There are few diseases that do not depend for their correct diagnosis upon the introspective report of sensations and feelings by the patient. It is obvious that one cannot detect abnormalities of behavior unless he is thoroughly familiar with normal behavior.

The understanding of normal behavior is not such a simple matter as it would be if all normal mental reactions were alike, for normality is distributed over a wide variety of performance. It is necessary, therefore, to know the nature and range of the individual differences that may be expected in any function, so that only the reactions which exceed this range shall be called abnormal. The matter may be illustrated in the case of weight as an indicator of health. Until recently there has been a tendency to place reliance upon the customary weight norms in estimating significant over- and under-weight. If one is above the standard for his age and height, he is too stout, and if he is below that standard, he is too thin. But there is a growing recognition of the fact that the normal individual variations are greater than were formerly supposed and that a person by virtue of his "build" may be far above or below the standard and still be perfectly sound. The interesting controversy concerning the skin sensations called "epicritic" and "protopathic" and what happens to them in disease is due in part to the differences of opinion as to what the sensations are really like under normal conditions.¹ It is the business of psychology to establish these norms of reaction, including the range of individual differences that may be expected. Although a large body of such data is at hand, it should be made more available for the medical practitioner. Familiarity with this material should be acquired as a part of a medical training. It is, indeed, difficult for the doctor to acquire such information in the course of his practice, since he deals with persons who come to him only because they are sick.²

The study of normal association reactions by Kent and

¹ E. G. Boring, "Cutaneous Sensation after Nerve Division," *Quarterly Journal of Experimental Physiology*, Vol. X (1916), pp. 1 ff.

² The most accessible collection of such material will be found in G. M. Whipple, *Manual of Mental and Physical Tests* (Warwick and York, Baltimore).

Rosanoff³ will serve as an illustration of the use of psychological norms in diagnosis. A list of 100 words was arranged, and the free associations to these 100 stimulus words, in the case of 1,000 normal people, were experimentally determined. When the character of these associates was studied, it was found possible to make out normal tendencies in the case of each stimulus word, and also a normal range of variability. When these associations were classified according to quality, under such headings as rhyme, neologism, perseveration, individual reactions, etc., the association types of normal people could be made out.

There should be included within the study of the normal behavior and the normal range of individual differences also the distortions, illusions and suggestibilities that influence the validity of report and which are nevertheless a part of the constitution of normal people. The variations in the meaning of a "severe" pain for different persons, the error in the location of a pain, the illusions of perception, the errors of memory and the influence of suggestion and expectation upon the character of the symptoms reported are only a few of the pitfalls of diagnosis. Many of the typical pictures of the psychoneuroses are now known to be the product of the suggestible patient unintentionally guided by the examining physician. The simple knowledge of the possibility of such phenomena will pave the way for taking measures against them. Willful deception frequently complicates the problem of diagnosis, and requires not only the ability to detect its presence, but also the ability to inspire confidence by manner, speech and otherwise, so that a maximum of coöperation between physician and patient may be obtained. Where these sources of error cannot be eliminated, the introspective report should be reënforced by more objective measures or the latter substituted for them wherever

³G. H. Kent and A. J. Rosanoff, "A Study of Association in Insanity," *American Journal of Insanity*, Vol. LXVII (1910).

possible. There is a growing tendency to adopt such objective methods as blood analysis, the analyses of the contents of stomach and intestines, the X-ray photograph, etc., primarily because they make possible the diagnosis of pathological changes before they register themselves upon the consciousness of the individual. However, there will always be numerous situations, especially in mental abnormalities, where such objective means cannot be employed.

Along with the knowledge of normal variations of behavior, there should go a knowledge of the technique of psychological measurement, in order that crude qualitative distinctions between what is normal and what is abnormal may give place to quantitative measures of difference. The need for quantitative methods follows naturally upon the recognition of the fact that normality covers a considerable range of performance, and that the difference between normal and abnormal is one of amount rather than of kind. The outstanding illustration of such qualitative differences is found in the case of intelligence, where the distinctions of idiot, imbecile and the like have given way to a statement of intelligence or mental age in terms of points of score or years of age.⁴

PSYCHOLOGICAL REACTIONS AS DIAGNOSTIC SIGNS

The psychological reactions that are accepted as symptoms of disease are so numerous and cover such a wide range of nervous and other diseases that it is feasible only to select a few samples from the various classes of mental experience. The sensory reactions furnish a multitude of symptoms in the nervous diseases. In hysteria, for instance, there may be a loss of the sensations of warmth or cold or both in certain limited portions of the body, diminished sensitivity or com-

⁴ For a collection of psychological methods suitable for the examination of patients, see S. I. Franz, *Handbook of Mental Examination Methods* (The Macmillan Co., New York, 1919).

plete loss of the pain sense, or exaggerated sense of pain there may be also anæsthesias of varying degree and extent. The sense of vision is frequently restricted to a narrow field, and sensitivity to colors may be likewise limited. Tabes dorsalis is characterized by a loss of the sense of movement and position of the limbs, accompanied by a local loss of pain sense and the sense of touch. Motor symptoms such as paralyses, tremors, contractures, disturbances of the gait, and the aphasias are symptoms in such diseases as general paralysis, arteriosclerosis, cerebral hemorrhage, and diseases of the cerebellum.⁵

More interesting, though perhaps no more important, are the disturbances of the higher mental functions as indicators of disease. One measure of such disturbance is the Kent Rosanoff Association Test mentioned above. The 100 test words have been given to patients suffering from various diseases and their reactions have been compared with those of 1,000 normal people. The value of the test depends upon the assumption that the idea which comes to mind and is expressed, when a given stimulus word is presented, will come from the past experience of the individual, and further, the idea which has been experienced and associated with the stimulus word most frequently will be the one that will come to mind most readily under normal circumstances. Thus, for normal persons whose environment and experiences have been such as life in America affords, the most likely responses to a set of simple words can be predicted.⁶ When a person who follows instructions to respond with the first idea that occurs to him, gives queer and unusual reactions, that in itself may be taken as a matter which needs interpretation, for it indicates that the responses are probably not controlled

⁵ Abundant material of this sort will be found in E. L. Hunt, *Diagnostic Symptoms in Nervous Diseases* (W. B. Saunders Co., Philadelphia, 1914).

⁶ For a sample of such reactions see page 8.

according to the well-known psychological laws, and that some other influence is at work. Further examination may reveal a "satisfactory" reason for the divergences, but if not they may be taken as symptoms of mental disturbance. Kent and Rosanoff conclude from a comparison of the responses of 247 patients with the 1,000 normal cases: "With the aid of the frequency tables and the appendix, normal reactions, with a very few exceptions, can be sharply distinguished from pathological ones. The separation . . . simplifies the task of analysis and makes possible the application of a classification based on objective criteria. . . . In *dementia præcox*, some paranoiac conditions, manic-depressive insanity, general paresis, and epileptic dementia the test reveals some characteristic, though not pathognomic associational tendencies."

The hopes originally expressed that the association reaction test would furnish a highly sensitive instrument of differential diagnosis among the various mental diseases, has not been entirely sustained by subsequent applications of it in its simplest forms.⁷ The detailed analysis of particular associations, the statistical analysis of association times, and the use of more complex stimulus words and the survey of a wider range of diseases may manifest its value.

INTELLIGENCE AS A DIAGNOSTIC SIGN

A great variety of mental tests was applied by Tendler⁸ to a group of fifty psychoneurotics (neurasthenia, psychasthenia and hysteria) and their records were compared with normal persons. Table LIII shows the per cent of the psychoneurotics that reached or exceeded the median score of the

⁷G. Murphy, "Types of Word Association in Dementia Præcox, Manic Depressives, and Normal Persons," *American Journal of Psychiatry*, Vol. II (1923).

⁸A. D. Tendler, "The Mental Status of Psychoneurotics," *Archives of Psychology*, No. 60 (1923).

TABLE LIII. COMPARISON OF PSYCHONEUROTICS WITH NORMALS

	Per Cent of Psychoneurotics Reaching or Exceeding Median of Normals
Rote Memory	56
Ink Blot (imagination test)	52
Maze Test (learning time)	52
Mixed Relations	52
Maze Learning (accuracy)	46
Trabue Completion	46
Number Finding (speed of perception)	44
Dotting Test	42
Hard Directions (accuracy)	38
Mixed Relations (time)	34
Logical Memory	32
Free Association	32
Substitution	28
Knox Cube	28
Cancellation	26
Memory for Forms	24
Hard Directions (time)	14

normals. The tests are arranged in the order of the degree of overlapping, with the case of greatest overlapping at the top. The order of reliability of the differences resembles closely the inverse of the order of overlapping. Greater differentiation was obtained by making a combination of the Hard Directions Test (speed) and the Memory for Forms, and giving each an appropriate weight. The overlapping is then as follows:

12 per cent of psychoneurotics	reach or exceed median of normals
17 per cent of hysterics	reach or exceed median of normals
11 per cent of psychasthenics	reach or exceed median of normals
8 per cent of neurasthenics	reach or exceed median of normals

According to this investigator, the tests discriminate between normal and psychoneurotic persons, although they do

not discriminate among the different forms of abnormality. The tests used in this experiment resemble the components of intelligence examinations, so that it is possible to transmute the scores obtained into terms of mental age. When this is done, it is found that the average mental age of the psychoneurotics is 12.0 years and that of the normals is 14.3 years.

Hollingworth⁹ has found intelligence differences among the various functional neuroses in a survey of 1,172 cases in army hospitals, as shown in Table LIV, in terms of mental age. The median mental age of the whole group is 11.7 years, with the normal at approximately 14 years. The only cases coming within the normal age are the psychasthenics and the cases afflicted with cerebrospinal meningitis. Hollingworth attaches considerable importance to intellectual status as conditioning the form that the pathological symptoms shall take, and believes that, although one cannot discriminate functional neurosis from normality on the basis of mental age, nevertheless differential diagnosis among the various forms may be facilitated by determination of mental age.

MEASUREMENTS OF EMOTIONAL STABILITY

There is every reason to believe that useful symptoms of mental disease could be found in the realm of emotional reactions. Psychological tests of emotional stability, however, are few and not well adapted for distinguishing the normal from the abnormal. The Personal Data Sheet prepared by Woodworth¹⁰ offers the best illustration at present

⁹ H. L. Hollingworth, *The Psychology of Functional Neuroses* (D. Appleton and Co., New York, 1920). See also F. L. Wells and C. M. Kelley, "Intelligence and Psychosis," *American Journal of Insanity*, Vol. LXXVII (1920), pp. 17 ff.

¹⁰ The test is reproduced in S. I. Franz, *Handbook of Mental Examination Methods* (The Macmillan Co., New York, 1919), and H. L. Hollingworth, *The Psychology of Functional Neuroses* (D. Appleton and Co., New York, 1920).

TABLE LIV. THE INTELLIGENCE DIFFERENCES IN THE FUNCTIONAL NEUROSES

	No. Cases	Median Mental Age
Mental Deficiency	40	8.6
Epilepsy	339	10.6
Hysteria	177	11.5
Constitutional Psychopathy	48	11.5
Psychoneurosis	114	12.0
Concussion	41	12.3
Neurasthenia	83	13.0
Psychasthenia	10	14.0
Undiagnosed	232	11.6
Organic Nervous Disease	45	12.3
Psychosis	16	12.5
Cerebrospinal Meningitis	26	14.0

of what such a test might be like and what it might accomplish as a diagnostic instrument.

A set of 200 questions, covering symptoms usually reported in case histories of the mental diseases, was prepared so as to be answered by underlining "Yes" or "No," as shown in the few samples given below, where "wrong" answers are capitalized.

Do you usually sleep well?	Yes	NO
Are you bothered by fluttering of the heart?..	YES	No
Are you bothered much by blushing?	YES	No
Is your head apt to ache on one side?	YES	No
Do people find fault with you more than you deserve?	YES	No
Did other children let you play with them?	Yes	NO

The questions were answered by large numbers of university students and drafted men in the Army. Those that were answered "wrong" by the normal group were eliminated as useless questions. When given to a group of individuals known to be abnormal and including dementia præcox.

neurasthenia, epilepsy, hysteria and psychopathic personality, the average number of "wrong" answers was 36. It has been tentatively assumed that an individual giving 20 or more "wrong" answers should be suspected of instability, and one giving 30 or more such answers should be suspected of actual abnormality. Elaboration and further standardization of the test are in progress, which ought to make it more serviceable both for distinguishing abnormalities in their incipient stages and for differential diagnosis.¹¹

THE SEARCH FOR MENTAL CAUSES OF DISEASE

In the adjustment of the human organism to its complicated and varying environment, the mental aspects of behavior occupy a very conspicuous position. Likewise, the maladjustments that appear in the effort to survive are predominantly mental maladjustments. It is natural, therefore, to look for the causes of inadequate adjustments in the mental experiences. The essential point to note is that the individual must react in some fashion—complete inactivity is not compatible with the continuation of life—hence maladjustments rather than absence of adjustment. The particular form that the individual adopts to meet the obligations of life gives the character to his disease.

It is not necessary for our purpose to enter into the discussion of the question whether there can be functional disorders independent of organic derangement, although this question has been and still is the subject of controversy.¹² It will be sufficient to state that psychological concepts are most applicable to the so-called functional mental and nervous disorders, without attempting to catalogue them.

¹¹ See E. Mathews, "A Study of Emotional Stability in Children," *Journal of Delinquency*, Vol. VIII (1923), No. 1.

¹² See W. McDougall, *Outline of Abnormal Psychology* (Charles Scribner's Sons, New York, 1926), Chap. 2.

THE CONFLICT OF MOTIVES

The process of adjustment presupposes an organism equipped with certain tendencies to action, or motives, and a complex environment in response to which the motives lead to action. The conflicts result from the interplay of the motives themselves and from the obstacles to their satisfaction which are interposed by the social and other forces of the environment. This conflict of tendencies, as conceived by McDougall, is described in the following paragraphs:¹³

Man's nature is such that his conduct is prompted and sustained by tendencies or purposes of two great classes that are not easily harmonized, the tendencies to secure the welfare of the self, and the tendencies to secure the welfare of the species and of the social community. It is only under peculiarly favorable social conditions that any individual can approximate to entire harmonization of these two groups of tendencies. Their opposition, their liability to conflict with one another, remains the principal ground of functional disorder. This is the great truth which, elaborated in a somewhat distorted fashion, underlies the Freudian psychology. But this opposition of primary biological function is not the only source of conflict in the individual, as the Freudian psychology would have us believe. Each of the instinctive tendencies of human nature seems to struggle for its own maximal development, and to be capable, under favoring circumstances, of becoming hypertrophied until it dominates the whole organism, becoming the main channel for all its vital energy. And it is only by the perpetual rivalry and reciprocal checking that obtains between the several tendencies that each is kept in due subordination to the whole system. When any one tendency, whether because it is natively of too great strength or because it is too much stimulated and favored by the circumstances of the individual, becomes so strong that it is not easily kept within due bounds, the process of reciprocal checking is exaggerated in intensity and becomes what we called inner conflict. There is thus no sharp line to be drawn between morbid or

¹³ W. McDougall, *Outline of Abnormal Psychology* (Charles Scribner's Sons, New York, 1926), pp. 49 and 216.

pathogenic conflict and the normal processes of reciprocal inhibition by which alone all harmonious life and development are maintained.

Happy is the man whose character has been formed from a well-balanced disposition under the influence of unquestioned ideals and of a definite supreme goal or master purpose. His self-respect and the ideals to which he is attached will supply him with dominant motives in all ordinary situations, motives strong enough to overcome all crude promptings of his instinctive nature; he is in little danger of becoming the scene of serious enduring conflicts; especially is this true if he has learned to know himself, has learned by reflection and frank self-criticism to understand, in some measure, his own motives, and has formed a sober, well-balanced estimate of himself, of his capacities, his purposes and his duties.

REPRESSION OF TENDENCIES TO ACTION

As all mental conflicts of this nature are uneconomical of energy, and if prolonged may become exhausting, the most common means of escape from them is to suppress or forget one or the other tendency. Such suppression, however, will leave the tendency active, and it will tend to express itself if the stimulating circumstances are not modified. For instance, the gnawing pains of hunger may be suppressed for a time by concentrating the attention upon the benefits to be derived from fasting, but the desire for food will force itself upon the attention at times until the appetite is satisfied. A process of rationalization frequently occurs whereby the individual justifies to himself the forbidden course of action. Many examples of such behavior will be found among drug users. The following history is typical. A young doctor sought to offset the effects of the strain of overwork by resorting to the use of a drug, feeling that he could readily resist the formation of a habit. After the habit had become fairly well established, he took carefully adjusted doses of atropine so as to counteract the contraction of the pupils of his eyes (the effect of the drug) and thereupon argued to

himself that he was resisting the effects of the drug. When his family and friends became suspicious of him and began to watch his movements he reasoned that he would show them that he was more cunning than they. He thus further justified his use of the drug and invented all sorts of ingenious means of concealing and using it.

The more primitive impulses commonly undergo repression through the force of customs, laws of morality, codes of ethics and religion. If the ideals supported by one or more of these systems are sufficiently strong, the "baser" impulses may be crowded out of consciousness effectually during waking hours. In such a case they may express themselves in dreams. When the impulse is a powerful one and the need for repression is imperative, the form of expression that it will take is oftentimes such a gross distortion of the original form of behavior that it is unrecognizable to the individual himself. The curious symptoms of the neurotic are explained by the Freudians as a manifestation in disguised form of such suppressed impulses.¹⁴

PSYCHOANALYSIS

The system of the psychoanalysts is built up by the elaboration and modification of these relatively simple concepts. The conflicting tendencies conceived as mental phenomena are said to remain such even when suppressed, and are called a complex. Since they are not in consciousness, an Unconscious (or Subconscious) realm is conceived wherein they may reside. As they remain active while repressed, some agent must be responsible for keeping these impulses out of consciousness. This is the Censor, which stands guard over the passageway between the Conscious and the Unconscious. Explanation is required for the fact that the suppressed

¹⁴One of the most interesting descriptions, for the layman, of the phenomena of mental abnormality is to be found in B. Hart, *The Psychology of Insanity* (Cambridge University Press, London, 1918).

tendencies do at times manifest themselves in consciousness and in overt behavior in one form or another. This is found in the theory that the Censor is less acute during sleep so that the suppressed ideas elude its vigilance and appear in dreams. The Censor may be eluded also when the suppressed content appears in a symbolic form and is, therefore, not recognized in its true nature. Symbolism is said to be necessary during sleep in some cases so that certain especially tabooed inhabitants of the Unconscious may escape in dreams.

As suggested in the statement of McDougall quoted above, all tendencies to action do not play an equally important part in this chain of events. Usually one or other of them is given a dominant position. For Freud¹⁵ and many of his disciples, the sex drive is the one primarily responsible for all motivation normal and pathological. His Unconscious is populated with such suppressed desires. They become active while the individual is still in the period of infancy and may even then by slight accidents become exaggerated and distorted and pave the way for trouble in the life of the adult. Jung¹⁶ has adopted a much broader conception of motivation and the nature of the Unconscious than Freud. He replaces the sex urge by the urge or energy principle of life, the two most significant manifestations of which are the sex impulse and the nutritive impulse. Adler¹⁷ relegates the sex urge to a subordinate position and sets up in its place the self-assertive tendencies. Stekel¹⁸ adopts a still broader notion and, in addition to the sex urge, he emphasizes the importance of motivations emanating from religious feelings, the in-

¹⁵ S. Freud, *An Introduction to Psychoanalysis* (Boni and Live-right, New York, 1920).

¹⁶ C. C. Jung, "The Theory of Psychoanalysis," *Nervous and Mental Disease Monograph Series*, Vol. XIX (1915).

¹⁷ A. Adler, *The Practice and Theory of Individual Psychology* (Paul, London, 1924).

¹⁸ W. Stekel, *Conditions of Nervous Anxiety* (Paul, London, 1923).

instinct of self-preservation and ambition. A further concept, belonging especially to the Freudian system, makes way for drawing off or diverting the energy of the suppressed tendencies into other and more socially acceptable channels. This "sublimated" energy accounts for the inspiration and urge toward art, science, business, industry, in fact all useful work.

The theories of the functional disorders differ somewhat according to the conception of the fundamental drives. Freud finds the root of all neuroses in the sex instinct, which has been suppressed and which finds expression in the bizarre reactions of the neurotic. The symptoms are disguised fulfillments of the sexual impulses. Jung finds the cause of the neuroses in the blocking of the form of expression which the vital energy normally takes in adaptation to the demands of life. This energy accumulates and, being denied an appropriate outlet, escapes through more primitive modes of expression, which are the abnormal or neurotic manifestations. Adler believes that "all forms of neurosis and developmental failure are expressions of inferiority and disappointment," in other words are due to the thwarting of the self-assertive tendencies.

The diagnosis of the particular disease, according to the psychoanalytic system, consists in bringing to light the suppressed content and explaining the symptoms to the patient in psychoanalytic terms. Since these very data have been suppressed and manifest themselves in consciousness only in symbolic form, some indirect means must be employed for their exposure. Chief among these is the analysis of the patient's dreams, where less disguise is necessary for the escape of the desires. The chief instrument in such interpretation is the set of fixed symbols for the elucidation of the dream content. Day dreams, phantasies, slips of the tongue and pen, lapses of memory, phobias and obsessions are likewise analyzed by means of symbolism. Concerning this

method McDougall¹⁹ says: "The world of concepts in which Freud conducts his tours of discovery is so fluid and shifting that it lends itself to every manipulation. Every emotion and every sentiment is ambivalent, is both itself and its opposite, and can at a moment's notice be transmuted into something radically different; every sign and symbol and symptom can be interpreted in opposite ways. There is only one fixed point, one invariable rule, namely, that, in one way or another, everything must be given a sexual significance."

As a demonstration of the technique of dream analysis, the following dream is reproduced, together with an interpretation suggestive of the Freudian methods and another which is based upon more acceptable psychological principles.²⁰

The dreamer, a man of thirty, takes a one o'clock train to meet professional engagements in a town that is distant by an hour's run. Having been forced to miss his luncheon, he decides to substitute a siesta for the meal. He falls asleep and does not wake until his ears are assailed by the sound of the car wheels taking the switch and rasping on the curved rails leading into the train-shed at his destination. The following dream occurs: "I see a child, apparently six years old, in a plain brown dress with a short skirt, standing on a chair in front of a cupboard the open door of which reveals the shelves within. The child's back is turned, while it reaches above its head to replace on a shelf, a jam-pot, from which liberal sustenance has been taken, as evidenced by the jam-bedaubed hand and the cheek in profile. Suddenly, the child turns from this business as if caught in

¹⁹ W. McDougall, *Outline of Abnormal Psychology* (Charles Scribner's Sons, New York, 1926), p. 413.

²⁰ The writer is indebted to L. H. Horton for furnishing this dream and the essentials of its interpretations. For a more detailed account of the dream and the analysis of it see his *The Dream Problem and the Mechanism of Thought* (The Cartesian Research Society of Philadelphia, 1925).

the act, bringing into full view a surprised and horror-stricken visage. The emotion thus portrayed is one I (as dreamer) soon come to share, as an apprehension justified by an unearthly screech apparently emanating from outside the pantry, first as if from the kitchen near by, and then as if from outside the pantry window. Finally the sound seems to hover about in unlocalized fashion." The dreamer then awakes to the stridulant and screeching noise of the car wheels grinding on the curve, as they turn into the station-yard at his destination.

A Freudian analysis of this dream would look beyond the associations aroused by the sensory factors, sound and hunger, and would seek some motive or "drive." It would look especially for symbols related to sex anxiety. At once the girl-like clothing would suggest a tendency toward sex inversion. The sex ambiguity would be developed. As this is potentially present in a large portion of the population, there would be some plausibility in the suggestion. Attention would then be directed to the motive of fear. Was the dreamer fearing that he would be surprised in some forbidden act? In the innocent episode of the dream would be seen a latent desire that looks toward an adult form of wrongdoing. This desire is dramatized in the dream in the form of a childish prank and thus passes the censor. The validity of this interpretation would be determined through a careful probing of the memories for evidence of some particular anticipated situation that would correspond to these specifications.

The mechanism of suppression might, however, entirely conceal the real motive from consciousness and leave it to be inferred from the interpretation of symbols.

When, however, the memory was explored without the presupposition of sexual connotation, there was revealed an entirely different set of events. The harsh metallic sound aroused early memories of a cat which had had a fit in the

pantry and had tried to climb up the wall hung with pots and pans, and had thus created scraping and metallic sounds. The hunger also aroused memories of getting food from the pantry. Thus, two sensory cues both led to experiences in the pantry. In the dream state there could be no more relevant response to the sound and the hunger than the pantry events of childhood that were reinstated.

There is in this case no need to import into the interpretation of the dream the usual Freudian presuppositions. It is, indeed, incorrect to assume that the incitements for dreaming must be of a specially motivated order. They may be of any order. It would be equally wrong, however, to overlook the possibility of a more purposive type of response. The scientific interpretation of dreams requires that the truth should be sought, whether it reveals the mere impulse to resolve (or explain) a system of sensory cues or the desire for the satisfaction of sexual (or other) impelling motives.

Another means of discovering hidden content responsible for neurotic symptoms is known as the "free association" method. It consists in requiring the patient to start with some element of one of his dreams, a slip of speech or the like, and to let his mind wander freely from this starting point, reporting all ideas that occur to him, without any reserve or self-criticism whatsoever. The patient himself recognizes when a complex is reached, by the sexual content of the ideas. Jung's association reaction method differs from this in the fact that he presents a list of words and the patient is required to call out a reply to each word. Those words that provoke an abnormal reply, either in the character of the response or its delay, are said to be connected somehow with the suppressed complex.

Still another means of exploring the region of the Unconscious for its suppressed content and especially for those forgotten experiences of childhood and infancy that are supposed to be of so much significance, is the method of hypno-

tism. It is said to be useful also in the recovery of forgotten dreams, that make such excellent material for analysis and interpretation. It is not clear just why hypnosis should reveal complexes unless it acts as an exaggerated form of sleep and thereby reduces the repressive power of the Censor, or unless, by the added concentration of the attention which the patient is able to exert under the influence of the hypnotist, memories may be the more readily revived.

The Freudian concepts here outlined, as well as the method of diagnosis based upon them, have been subjected to severe criticism from the point of view of scientific psychology. The dominance of the sex motive, the Unconscious, the Censor, Sublimation, Symbolism, none of these concepts has attained a secure position in systematic psychology. Concerning the psychoanalytic theory, Woodworth²¹ says:

The pragmatic argument will not work in this case. We have a number of other treatments, all more or less successful in treating neurotic cases, and each one purporting to be based on a different theory. If the psychoanalytic treatment could be rigidly deduced from the Freudian theory and from no other known theory, or even if the practice had originated as a deduction from the theory, this argument would have weight. As a matter of history, however, the treatment grew up first, and the theory was then developed as a sort of rationalization of the treatment. The theory is extended far beyond the needs of the practitioner. The psychology of the Freudians, and also their views on history, mythology and the world in general, are not essential to the practice, but are to be regarded as products of the decorative art.

OTHER DIAGNOSTIC METHODS

Emphasis has been given to the psychoanalytic method, not only because of its prominence at present as a diagnostic

²¹For a critical examination of Freudian concepts, see R. S. Woodworth, "Some Criticisms of the Freudian Psychology," *The Journal of Abnormal Psychology*. Vol. XII (1917), pp. 174 ff.

instrument, but because of its influence upon the public mind, upon literature, upon religion, upon the interpretation of social phenomena and of the great events and characters of history. Other diagnostic methods are meeting with success, which are based upon the conception of conflicts among motives native and acquired, and which may be discovered by study of the personal history of the patient and by conferences with him after his coöperation has been secured. There is a growing tendency among practitioners to recognize in neurotic cases an hereditary predisposition, with the result that the particular symptoms that the disease may manifest, rather than the disease itself, are looked upon as the product of the conflicts which have been described. Among such predispositions are the character types, introvert and extrovert, suggested by Jung, the organic inferiority suggested by Adler, the low psychic tension and low reserve of energy suggested by Janet, and the vaguer concepts of the Freudians.

CHAPTER XXVIII

PSYCHOLOGY AND MEDICINE: III. THE TREATMENT OF DISEASE

THE conception of the functional diseases as maladjustments of the organism to the conditions of life implies in all methods of treatment a readjustment process—a readjustment of the individual in respect to his habits of living and his attitudes toward his problems and in respect to his emotional responses. It implies also, in many instances, a readjustment of the environment in a variety of respects, where it is necessary to meet native and unchangeable shortcomings of the individual. This essential readjustment may be accomplished in a number of ways, although one method may be more effective or more expeditious than another with a certain type of patient. Amid the confusion and controversy among rival techniques throughout the history of the psychological methods in medicine, one fact is clear, namely, that satisfactory readjustment of the patient has been accomplished by the most diverse and conflicting procedures. Cures by rest are matched against cures by excitation and by work, cures by fasting are matched against cures by forced feeding, cures by magic are matched against cures by religious symbols, cures by exhortation are matched against cures by silence. The search for the common element in all these treatments reveals the attempt to produce change from an inadequate, primitive or abnormal system of responses to a sane and healthy one. The fundamental psychological principles of education, or rather of reëducation, must be obeyed in this process of reconstruction.

This has not always been the case. The use of such words

as suggestion, hypnotism, synthesis, clarification of complexes, catharsis, does not always imply a thorough understanding of the mental processes involved, and it does not necessarily follow that the terms stand for any authentic mental processes. Much confusion has been created by pseudo-scientific writers who have attempted to arouse dramatic interest in certain phenomena of fatigue, automatism, drowsiness and hysteria, and have drawn into their service in this attempt the occult suggestions which have formerly emanated from the words, suggestion and hypnotism. The term reëducation has not been used in a strict psychological sense, but has stood for large and practical processes, with little attempt at psychological analysis, description or formulation. It has carried somewhat the meaning "to lend a helping hand," "set a good example," "give direction and advice," "provide an incentive," "give encouragement," "arrange for new surroundings," etc. All these phases, it is true, emphasize the mental functions of a psychological organism rather than its physiological processes. This emphasis is perhaps responsible for the first two syllables of the word psychotherapy. And it follows, of course, that acquaintance with the laws of mental and motor behavior, and with the elements, attributes and patterns of mental processes is favorable to satisfactory work on this plane, as it is also in teaching children, hunting wild beasts and selling goods. The use of such vague psychological concepts has not implied any very profound knowledge of the refinements of modern psychology but rather a sympathetic acquaintance and toleration for human nature. That is why successful therapeutic work has frequently been accomplished by ministers, school teachers and laymen.

PSYCHOLOGICAL DATA AS INDICATORS OF CHANGE

Before examining the strictly psychological methods of treating ailments, there is another form of application which

deserves notice. Just as in the course of diagnosis it is necessary to make use of mental symptoms such as pains, anæsthesias, worries, hallucinations, etc., so in the course of treatment changes in these symptoms will indicate progress of the disease. As an illustration of the psychological measurement of progress of treatment, the examination of hookworm patients made by Strong¹ may be given. By a series of tests he measured the mental alertness and capacity of children who were about to be placed under treatment. He examined in the same way a control group of healthy children living under the same general conditions, and also a group of hookworm-infected children who were not submitted to treatment. After the treatment the various groups were reexamined by the psychological tests and determinations made of such changes in mental condition as may be produced in the normal and untreated groups by mere repetition and growth, and in the treated groups by these factors plus medical treatment for the disease.

The results of this investigation enabled the investigator to draw the following conclusions:

The figures show, then, that hookworm disease unmistakably affects mental development. Treatment alleviates this condition to some extent but it does not, immediately at least, permit the child to gain as he would if he had not had the disease. And the figures apparently further show that prolonged infection may produce prolonged effects upon mentality—effects from which the individual may never entirely recover.

This investigation by psychologists bears out the claims advanced but not measured by physicians and zoölogists that the effect of hookworm infection may result in serious delay in development of mental activities of children and of communities, and may therefore have a seriously inhibitive effect upon the school problems and even upon the economic development of hookworm communities.

¹ E. K. Strong, "Effects of Hookworm Disease on the Mental and Physical Development of Children," *International Health Commission*, No. 3 (The Rockefeller Foundation, New York, 1916).

It emphasizes more than does any previous study the advisability of prompt medical treatment even of light cases, for the benefit of the children themselves and collectively for the better development of the community.

The feasibility of using the measuring methods of the psychological laboratory as an adjunct to and check upon clinical findings has been demonstrated by the same author² in the measurement of the progress of treatment for manic-depressive insanity.

It is to be expected that rough clinical observations unaided by experimental methods of quantitative measurement should at times be misleading. For instance:

. . . the maniacal condition appears to be one of accelerated mental and motor activity; but tests have shown that this appearance of speed is deceptive, and that the maniac should be called slow rather than fast in his thoughts and movements. Similar tests have shown that the condition of alcoholic intoxication which seems to make a man preternaturally prompt and fertile in the production of ideas is at bottom a condition in which the process of association is slower than normal, and in which the stock of ideas is impoverished rather than enriched. To take another sort of case, idiots appear to constitute a class by themselves, a subspecies of the race, but tests seem to prove that they are after all not separable by any sharp line from normal individuals, that there is no typical idiot standing at the center of a "distribution curve of idiots" but that they are simply those members of the race who differ in the most extreme degree from the normal type. There are probably numerous other instances, some of theoretical and some of practical importance, in which the current descriptions of abnormalities would be changed by the application of experimental methods.³

²E. K. Strong, "A Comparison between Experimental Data and Clinical Results in Manic Depressive Insanity," *American Journal of Psychology* Vol. XXIV (1913), pp. 66 ff.

³R. S. Woodworth, "Psychiatry and Experimental Psychology," *Proceedings of the American Medico-Psychological Association*, 1906.

TREATMENT BY SUGGESTION

Among the earlier methods of treatment, such as the use of magic, religious exercises, animal magnetism, as well as among the more recent developments of Christian Science and New Thought, suggestion seems to play an unwitting but important rôle. The element of mystery, wonder and power surrounding the curative agent are well calculated to put the patient in the state of expectation appropriate for effective suggestion. There are no particular theories underlying the methods included in this group, unless it be the complete denial of the reality of the symptoms such as occurs in some of the modern cults. The readjustments that are wrought are comparable with the experiences of religious conversion or with the breaking of a strong habit and the establishment of a new one in its place in the case of normal individuals. In fact the mechanisms of the treatment accord to a degree with James' ⁴ well-known law of habit formation, to "launch ourselves with as strong and decided an initiative as possible." When a sudden and revolutionary readjustment of habits and attitudes has been thus accomplished, a permanent cure may possibly ensue. But an effective treatment should follow James' instructions further: "Accumulate all the possible circumstances which shall reinforce the right motives; put yourself assiduously in conditions that encourage the new way; make engagements incompatible with the old. . . . This will give your new beginning such a momentum that the temptation to break down will not occur as soon as it otherwise might, and every day during which a breakdown is postponed adds to the chances of its not occurring at all." In other words, a real readjustment, whatever the method by which it is initiated, in order to conform to sound psychological principles, should include such a regulation of the environ-

⁴W. James, *Principles of Psychology* (Henry Holt and Co., New York, 1908), p. 123.

ment, and such a program of activities that the discarded reactions cannot recur. The method of suggestion, if it satisfies these requirements, may meet with success.

Hypnotism has been employed by Prince⁵ and a form of partial hypnotism or relaxation by Sidis⁶ for facilitating the readjustment process. It is reputed to be possible by these means, when skillfully used, to gain a maximum of coöperation from the patient, and by eliminating resistance and positive antagonism, to increase the speed with which new habits and attitudes can be established.

MORALIZATION

Closely related to the foregoing methods are those which employ persuasion, sermonizing, exhortation and moralization upon the patient. The doctor will explain the patient's condition to him and exhort him to adopt a more rational attitude toward life. This treatment will be repeated day after day and for hours at a time, until the patient finally succumbs, and accepts the proposed modes of reaction or is pronounced an incurable case. There is in this method a large component of suggestion either intentional or unintentional. It is more successful, naturally, where the physician inspires confidence and carries the authority engendered by a long list of cures to his credit. Psychologically, exhortation is not, when taken alone, a sound method of reëducation, and unless supplemented by the laborious process of establishing proper ideals and purposes and correct habits and attitudes, should be expected to be of very limited value. The whole trend of modern education is away from such methods and toward the use of properly controlled practice in the right course of action.

⁵ M. Prince, *The Unconscious* (The Macmillan Co., New York, 1914).

⁶ B. Sidis, *The Foundations of Normal and Abnormal Psychology* (Badger, Boston, 1914).

CONSERVATION OF ENERGY

Several methods of treatment seem particularly directed toward building up the energy supply of the patient, although they have been known as psychological methods. The rest cure associated with the name of Weir Mitchell has had a long history. Rest is sometimes supplemented by complete isolation and the prohibition of conversation. Where the personal history of the case shows evidence of exhaustion, such treatment is advocated by Janet and others as a preliminary to psychological treatment. It would seem logical enough, in the treatment of mental as well as physical ailments, that the body should be well nourished and as free from fatigue as possible. The rest and isolation have been used frequently as the curative process rather than as a preliminary to it. It has been suggested that the treatment acts as a kind of punishment, which is more unpleasant than the condition which the patient escapes by the adoption of his symptoms. Hence, he is led to readjust his behavior in order to escape the punishment. This treatment is usually accompanied by persuasion on the part of the physician with the suggestive influence that this implies. As stated above, such devices may serve as secondary aids in directing the course of the readjustment.

Economy of energy is an especially vital factor in the treatment of the neuroses advocated and practiced by Janet. For him the neurotic is an individual who is constitutionally deficient in energy or, at least, is one whose stock of energy is readily depleted as the result of emotional shock, fatigue or strain of any sort. "Most disorders of behavior result from a lack of these forces. If I may be permitted such a comparison, all these diseases are nothing more than various ways of going bankrupt and falling into misery. . . . Nothing is more urgent when one is confronted by an individual on his way to bankruptcy than to reduce his ex-

penses and to establish a strict economy.”⁷ The treatment consists, not in confining the patient to complete rest in bed, but rather in a simplification of his living conditions. His complicated situations must be resolved, his responsibilities must be reduced, his decisions must be made for him, prolonged effort must be avoided, and the need for adaptations to changed conditions must be reduced to a minimum.

PSYCHOANALYTIC TREATMENT

The psychoanalytic treatment consists in redirecting the energy of the sex impulse (or other impulses according to the theory) which finds outlet in an abnormal attachment to some object or person, and the expression of which constitutes the symptoms of the neurosis. This readjustment is known as sublimation. The procedure consists, first, in the transference of the attachment to the analyst, from whom it is then redirected or sublimated into various useful channels. The impulse remains the same, while the means of attaining its satisfaction are found in a great variety of dignified reactions. McDougall describes the process of sublimation as follows:

If a puppy is taught to obtain food by sitting up and “begging” for it, instead of straightway seizing it in his teeth, that might be called intellectual sublimation of the simplest kind; and if, in the service of the same impulse, he learns to perform a complicated trick in order to obtain his food, that is a further stage of the same process. In the same way, if a child, instead of being allowed to obtain what he wants (food, or any other natural goal) by merely seizing it or clamoring for it, is taught to earn it, as the reward of a useful or kindly action, he is being led to sublimate his instinctive energies. In the animals only a very limited kind of intellectual sublimation is possible; but man is capable of vastly greater intellectual sublimation;

⁷ See W. McDougall, *Outline of Abnormal Psychology* (Charles Scribner's Sons, New York, 1926), p. 15.

and, what is more important, he is capable of moral sublimation; that is to say, man can learn to substitute for his natural goals, goals higher in the moral scale; the same instinctive impulses that would have impelled him towards the natural or instinctive goal, then sustain his efforts toward the higher goal.*

According to the Freudian view, the sex impulse, diversified thus by the process of sublimation, is the driving force toward all life's intellectual, ethical and æsthetic activities. Sublimation, thus interpreted, is almost, if not entirely, co-extensive with education, although education is not assumed to derive its impelling force solely from the sex impulse. The exact technique by which the sublimation is accomplished differs somewhat according to the particular point of view of the psychoanalyst, but for all it consists in the delicate process of guiding and inspiring the patient into a normal course of behavior. It comes about as the culmination of long and repeated conferences between physician and patient, during which the closest confidence is established between them through the act of transference. The personality of the physician thus plays a very significant part in the treatment. The guidance is aided and facilitated not a little by the use of suggestion, a device which at one time was repudiated as foreign to the psychoanalytic method, but has recently been acknowledged as a distinct aid. Barring the particular terminology and the emphasis upon the sex tendencies, the sublimation process is closely akin to those already discussed.

REEDUCATION

All the methods of readjustment thus far mentioned are in a sense forms of reëducation, although the psychological principles underlying educational methods are subordinated to some special theory or are entirely neglected. The re-

* W. McDougall, *op. cit.*, p. 473.

education method advocated and employed primarily by Franz, Wells and others in America represents an approach to the problem from the psychological point of view. The patient is viewed from normality as a starting point, and all his reactions are treated as deviations from the normal. This difference in approach may appear to be of little consequence, yet it frequently has a pronounced influence upon the methods of treatment. A specific instance cited by Franz⁹ will be given. A patient was suffering from an apparent inability to speak and write as a result of a gunshot wound in the neck, which was supposed in some way, such as the severance of nerves, to have caused the disabilities. He was brought, for special examination, by his physician who reported the circumstances of the case and the efforts that had been made toward reëducation.

After greeting him I asked the patient his name. His lips moved, but the physician, who was present, immediately interrupted with the remark: "Mr. — cannot talk." I insisted, however, that the patient had begun to talk to me and that he should be permitted to continue without interruption. I assumed and acted upon the assumption that he could talk, and I found that he could talk. Although his voice appeared weak and somewhat tremulous, he verbally gave me his name and subsequently a few details regarding his life. He exhibited no evidence of inability to carry on an ordinary conversation and I assumed at all times that he was capable of doing this. A pencil and paper were then provided, which I handed to the patient, placing the pencil in his right hand with the request that he write his name, his age, the date, his home address, and the place where he then was. Before he could begin the task, the physician again advised me, sharply and in tones distinctly audible to the patient, that the latter could not write with his right hand. He also took the pencil from that hand and placed it in the left, which he said was being reëducated to take up the writing functions. Without comment, I took the pencil from the patient's

⁹S. I. Franz, *Nervous and Mental Reëducation* (The Macmillan Co., New York, 1923), pp. 209 ff. and pp. 17 ff.

left hand and placed it in the right hand, and ordered him to write, which he showed he was capable of doing.

The patient proved to be psychoneurotic and his disabilities were in danger of being fixated by the attitude of the physician that there *must* be something wrong. At the same time this attitude counteracted the beneficial effect of the expectation that the patient was normal and could perform the tasks required. According to Franz, "the principle of reëducation is that of habit formation. It is either a replacement of old, inadequate or harmful methods of reacting with new habits more like those of the other individuals in his environment, or it is the formation of new habits to take the place of those that have been lost. In other words, reëducation is to the abnormal what education is to the normal—it is a matter of acquisition of habits that will enable the individual to take his place in the working, playing, social world."

The successful reëducation of patients with functional disorders requires that the patient have some insight into his abnormality, at least to the extent of recognizing that he is different from other people; that he must have or acquire the desire to get well and be like other people; that he must have confidence in his ability to get well; and that he must have confidence in his physician or instructor. Finally he must have careful guidance and supervision in the course of the reëducation process. All the devices that have been found to be effective in facilitating learning and giving it a permanent fixation should be employed. The proper distribution and duration of trials, the demonstration of improvement by measurement and recording of performance, and the use of incentives to effort appropriate for the particular case may be borrowed directly from the psychological laboratory. The generous use of suggestion and encouragement are recognized as valuable assets

THE PSYCHOLOGICAL CLINIC

An important development of applied psychology in recent years has been the psychological clinic. In such clinics individuals are examined by various methods and scales of mental measurement. By these means it is possible, to a degree of accuracy and completeness never before attained, to determine the mental condition and status. Such determination in these days of individualized pedagogy, individualized punishment and industrial emphasis on the individual worker is a highly desirable procedure for educational, criminological and vocational diagnosis.

The contact of psychology with medicine at this point arises from the fact that the determination of mental status has in times past, for rather obscure and complex reasons, been assigned to the medical man, rather than to the educator, lawyer, clergyman or psychologist. Commitment for lunacy, invalidation of wills, evaluation of testimony, appointment of guardians and determination of legal or criminal responsibility are still in many parts of the country dependent on the verdict of physicians whose chief practice may be in surgery or obstetrics. This has been the case although in only two or three medical schools is the prospective physician required to give any appreciable amount of his time to the study of mental normality or disorder. Even the work of institutional administration and superintendence has traditionally been that of the physician, when mental deviates and their care were in consideration.

In the psychological clinic of to-day as well as in the progressive hospital for the mentally disordered and defective, both psychiatrists and clinical psychologists will commonly be found applying to the concrete problems of education, charity, justice, industry and social administration, such of the content and technique of medical and psychological science as may be found serviceable.

PSYCHOLOGY AND THE MEDICAL SCHOOL

The importance of psychological data and methods as adjuncts to the more customary diagnostic and treatment methods, and directly in the diagnosis and treatment of mental disorders, as well as their importance in the understanding of the personality of the patient, raises the question of the place psychology should occupy in the medical school. When the curriculum of the typical medical school is analyzed, it is found that the experience and training of the student are largely clinical. This means that his observation is for the most part of pathological conditions. He may easily fail to acquire sufficient information concerning normal types, and the direction, conditions and range of normal variability. Such knowledge, which might well be partially furnished by adequate psychological training, would at least warn him of the fallacies of generalizing clinical findings without due regard for the facts of normal variability.

The medical course as it is now offered seems to provide little training in exact and purposive experimentation. An excessive proportion of the student's time seems to be occupied with the memorizing of anatomical minutiae, the most of which are straightway forgotten, the disciplinary value of which is at least questionable, and the content of which is always accessible in the manuals. It seems for these reasons that one of the most fruitful contributions which psychology may yet make to medicine may be a rigorous, specially adapted, full-year course in experimental psychology, which should be incorporated at an early point in the curriculum of the medical schools. In such a course much stress should be laid on methods and technique of arriving at experimental certainty, avoiding logical fallacies and inductive errors, and of adequately controlling the grounds of inference under circumstances in which very slight factors may play important rôles.

In recent years there has been a slowly developing tendency to introduce special knowledge and skill of a psychological sort into hospital service, in connection with examination and case work, nursing, therapy and research. During and since the recent war this movement was given an impetus through the recognition that the reconstruction of patients in the military hospitals was in many instances essentially a reëducational process. Not only in neuropsychiatric hospitals but also in institutions for the care and treatment of orthopedic and surgical cases, and for the blind, deaf and tubercular, and especially in connection with occupational therapy points of contact were found between psychology and medicine.

Occupational activity has not only its aspects of diversion and exercise, but may be specifically directed toward the restoration of particular members, functions and muscle groups. After an inventory of the patient's aptitudes and interests, his intelligence and educational preparation, such work may be more intelligently and effectively directed toward the patient's ultimate advantage as well as toward his present functional requirements. The well-established principles of educational psychology are entirely relevant to the processes of reëducation as well, and reëducation is coming more and more to be recognized as an important phase of therapy. Educational psychology and its applications may afford assistance not only in the technique of reconstruction, but also in the preliminary inventory of capacity and disability.

Furthermore, many patients will require vocational readjustment after discharge, and experience shows that a competent vocational psychologist may also be of service in this process of readaptation to economic and social life. During the hospital residence and after discharge or parole, moreover, the general factor of morale has high importance. Whether the development and maintenance of morale be

undertaken by physician, nurse, social worker or psychologist, it is definitely a psychological undertaking.

In particular instances, notably in conditions such as aphasia, functional nervous complaints, various paralyses, and in recovery after operations and amputations, intensive individual reëducation has great usefulness. There is reason indeed to believe that a certain proportion of individuals who now deteriorate under institutional treatment might profit materially through discerning individual reëducation. This seems even to be the case in those psychiatric pictures commonly diagnosed as *dementia præcox*, in which the prognosis is usually considered unfavorable.

The value of psychological measurements and records of the changes in capacity under given remedial measures has already been indicated. By such means not only may useful records be secured for correlation with the therapeutic measures, but the patient's attitude toward his own condition and toward the therapy may be usefully improved by picturing to him concretely the actual increments of functional restoration from day to day.

Finally the hospital psychologist may undertake various research projects, following up clinical, experimental and statistical suggestions, especially in cases where the patient's conduct and general adjustment to life are of special concern. In the case of neuropsychiatric conditions these suggestions are especially relevant, and it is in such conditions that the application of the psychologist's skill and knowledge is regarded most hopefully.

CHAPTER XXIX

PSYCHOLOGY AND EDUCATION

THE field of education represents the first practical activity in which the applications of psychology were made in any systematic way. So numerous and so varied have these applications become that a working knowledge of psychology is now quite generally required of all teachers. In training schools for teachers the courses in general, experimental, genetic, abnormal and differential psychology constitute an important part of the curriculum. Books on the principles of teaching quite commonly begin with some such statement as, "The art of teaching is based primarily on the science of psychology." Not only have certain facts and principles of psychology become systematized into a body of "educational psychology," but the individual and group methods of the laboratory have been adapted to special educational problems under the name of "experimental pedagogy" or "experimental education."

Between these two fields, psychology and education, the coöperation has been so long established and so cordial that the content of general psychology has been much enriched through investigations, the primary problems of which were educational. Furthermore, practically all the matters dealt with in preceding chapters have a direct bearing upon the problems of education and many of them represent portions of the content of educational psychology. Since these things are true, this chapter on the relation of psychology to education will indicate only the main directions of application and

give suggestive illustrations of those that have not been discussed.⁴

THE INDIVIDUAL AS THE UNIT OF MODERN EDUCATION

The application of psychology to education forced attention upon the individual, and impelled educators to adapt methods of instruction to suit him. This shift of attention from the earlier theories of education to the concrete facts about individuals brought about a revolution in educational methods quite as radical as those which later occurred and are still occurring in business and industry. In all these fields the new concept has gained such impetus that no obstacles, whether institutional, administrative or financial, can long withstand its advance. The changes in education have been so great and so widespread as to leave practically no single person unacquainted with them. The early conceptions of education treated it as a single, unitary process, whose function it was to "train the mind," "mold character" and "give culture."

A real step, however inadequate we may now consider it, was taken when "the mind" was analyzed into distinguishable and nameable "faculties" and the effectiveness of teaching regarded from the point of view of those faculties and their separate treatment. Still more wholesome and influential was the further step in analysis in which these faculties (such as memory, instinct, imitation, perception, attention, will) were realized to be but convenient and artificial names given to various groups of specific habits and tendencies. With these steps went the breaking up of "learning" or "culture" into more elementary and constituent aspects, the deliberate separation of school subjects from

⁴ Following are two well-known textbooks of educational psychology: E. L. Thorndike, *Educational Psychology* (Teachers College, Columbia University, New York, 1915), and D. Starch, *Educational Psychology* (The Macmillan Co., New York, 1919).

each other, and attempts to correlate them in the curriculum in such a manner that each set or group of tendencies or habits would be given adequate attention, exercise or inhibition.

In time this same analytic process led to the discovery that a "school subject," such as arithmetic, is by no means a unitary enterprise on the part of teacher or student, but in itself involves a considerable variety of more elementary processes, each of which must be considered in detail if the whole is to be adequately and economically mastered. Thus in arithmetic the ideas of amount, of units, of sequence and position, of counting, of grouping, and of manipulating, familiarity with the symbols, comprehension of the operations and meanings which the symbols denote, must all be recognized. Questions at once arise concerning the most "psychological" sequence and organization of these various functions and processes. In a similar way in the subject of drawing, the various tendencies and features of ornament, symbolic portrayal, pictorial representation, diagramming, and finally mechanical drawing are distinguished. Other "subjects" receive, at the hands of the educational psychologist, the same type of detailed analysis.

Not only is the school subject thus reduced to its constituent processes, but each operation in one of these processes is ultimately analyzed into a group of still more specific acts and habits. Thus in such a simple operation as adding a column of numbers "investigation seems to give evidence that . . . eight or nine distinct functions are involved, each of which involves the use of several bonds. Besides these positive connections, a child in learning (to add) must inhibit other connections which are incorrect, and these must often outnumber the correct ones. And yet column addition has always (heretofore) been treated as a simple habit—with perhaps one element of complexity when carrying is involved. It is evident that if the habit concerned does in-

volve eight or nine different functions, a child might go astray in any one. His difficulty in forming the habit might be in connection with one or several of the processes involved. Knowledge on the part of the teacher of these different steps of the habit, and appreciation by him of the possibilities of making errors, are the prerequisites of efficient teaching of habits."²

In a similar way such a concept as that of the child's "will" has been clarified only by analyzing it into the constituent instinctive and emotional trends; these instinctive trends understood only by the enumeration of the specific bonds and reactions which the "instinct" includes;³ and the emotions comprehended only by breaking them up into the elementary feelings and their combinations. These changes have clearly paralleled the analyses of physiological psychology, from the conception of the unitary brain as the "organ of mind," through the reduction of this unit into "areas" or "regions" of localization, the analysis of these "regions" into "arcs" and "pathways," and finally to the "neurone theory" and the consideration of particular conduction units, synapses, conditions of preparedness and readiness, inhibition, facilitation and integration.

THE CONCEPT OF INDIVIDUALITY APPLIES TO THE TEACHER AS WELL AS TO THE STUDENT

In modern administration and supervision there is to be seen a definite tendency away from the vague characterization of a teacher as "a good teacher," a "fair" one or a "poor" one, and toward a thorough analysis of "teaching ability" into its elements. Moral influence, social activity, discipline, leadership, instruction, etc., come to receive inde-

² G. S. Strayer and N. Norsworthy, *How to Teach* (The Macmillan Co., New York, 1917).

³ See E. L. Thorndike, *Educational Psychology* (Teachers College, Columbia University, New York, 1913), Vol. I.

pendent recognition and evaluation. Indeed each of these is realized to be complex and the task of "teaching a class," from the point of view of instruction alone, is analyzed into such distinguishable though by no means unrelated steps or stages as "preparation," "presentation," "comparison and abstraction," "generalization," "application" and "drill or review." "Faulty instruction" can thus be understood or remedied only by the analysis of one of the qualifications of a teacher into still more elementary aspects. Rugg,⁴ for example, has prepared a chart for the evaluation of teaching ability, which includes about fifty specific traits necessary for successful teaching.

THE RAW MATERIALS OF EDUCATION

Perhaps the earliest contributions of psychology to education were in the form of facts or laws of mental life. Indeed long before psychology became recognized as an independent field of scientific inquiry writers on educational subjects were mainly occupied with discussions concerning the nature of the child's mind, the sources of his interest, the varieties of his powers and the modifiability of his capacities. The work of education came to be conceived as that of effecting changes in the behavior or feeling of the individual who was taught. The possibility of these changes was, of course, seen to depend not only on their social or parental desirability but most of all on the materials afforded—the fund of traits and tendencies with which the individual is originally equipped, and the degree, permanence or modifiability of these traits.

The "original nature of man," his inborn tendencies to attend, react and retain, his predispositions, the range and

⁴H. Rugg, "Is the Rating of Human Character Practicable?" *Journal of Educational Psychology*, Vol. XII (1921), and Vol. XIII (1922).

limits of his capacities, the rate at which these mature, the conditions of their effective activity, their transitoriness, their mutual inhibitions and reënforcements, the teacher is compelled, either beforehand or through painful experience, to learn. For these original traits are given only in the form of certain large and vague tendencies and the task of education consists in so working with these vague original tendencies as to make the individual effective in the circumstances and for the purposes for which he is to live. Some of these tendencies must be inhibited if the individual is to be socially adapted, as, for example, his tendencies to take what he sees, to strike when injured or affronted. Other tendencies must be selectively trained, stimulated and specialized, as his tendencies to vocal utterance, to motor activity, to construction. Still other tendencies must be directed, modified and transformed, as those to inquisitiveness, to collection of objects, to play and to hunt. In such processes it is important to know in some detail the ways in which original tendencies may be modified, the consequences of their enforced suppression, and their futility unless directed. Punishment, disuse and substitution may all be employed in this process, but by no means all of them with equal success or on all occasions.

DEVELOPMENT OF THE INDIVIDUAL THROUGH EDUCATION

Reaction tendencies in the form of feeling, conduct or knowledge, not provided by original nature, must be impressed on the individual in the form of habits. Talking, reading, writing, using a machine, the multiplication table, and a thousand habits, simple and complex, must all be individually acquired. It is the task of education to see that these habits are most adequately, economically and permanently acquired. Here, then, all the laws of learning, all the studies of memory, all the facts and principles of habit formation, interference, forgetting, association, etc., are of

vital importance in the operations of the classroom, the laboratory and the textbook. Studies of animal learning yield principles which may be directly utilized in teaching the human being. The advantages of spontaneous effort over mechanical repetition, the relative effectiveness of reward and punishment, the influence of motive and incentive, the inadequacy of imitation, the importance of pleasure in success, the expectation of a systematic curve of learning, the meaning of plateaus, the value of determining tendencies, intentions and purposes, the value of problem or project, the character of play tendencies and their possibility of useful organization and direction, the specific nature of habits, the absence of any considerable transfer from one field to another, the significance of identical elements in materials, work habits or general attitudes, all these are but random selections from an endless list of principles which have been evolved from psychological investigations in the laboratory and in the classroom.

A familiar experiment of the psychological laboratory consists in the observation and recording of the processes gone through in acquiring some new habit or act of skill. An animal may be placed in a cage from which it can escape only by performing some simple or complex set of movements, after which it may be rewarded by food. Or a human being is given some new task to learn, such as solving a puzzle, acquiring dexterity in some muscular feat, or becoming proficient in the use of some instrument, some set of symbols, some type of judgment. Records of the modes of attack, variations in method, types of errors, rate of learning, conditions of improvement, degree and ease of retention, tendency to distraction and interference, effects of disturbance, introspections of the worker, and similar facts, enable the experimenter not only to picture in a graphic way the course of the act of learning, but also to formulate various general principles concerning the relative

effectiveness of different methods and the differences between individuals.

The work of the teacher consists mainly in supervising the formation of habits of these and related types. It is therefore found useful for the teacher to become familiar, through performing such experiments in the laboratory or observing them in the demonstration, with the tendencies and principles underlying the learning process. In a similar way the classical experiments in memory, perception, attention, etc., all have their technical and professional value in picturing in concrete and systematic form the psychology of the pupil. It would be difficult to find a classical psychological experiment that does not, at some point or other, admit of practical application in education.

If now, for the more or less artificial materials and acts of the laboratory, the mastering of actual school subjects and operations be substituted, the laboratory technique leads to a genuine experiment in education, especially if the experiment be performed on such individuals as comprise the school population. In this way the value of various methods of instruction, arrangements of material, amounts of drill, distributions of practice, proportions of study, rest and recitation, lengths of class period, etc., may be accurately and quantitatively determined. In such cases the laboratory technique is employed not merely by way of illustration, but as an instrument of educational research.

By such experimental methods, for example, one pioneer investigator⁵ was able to measure the arithmetical abilities of pupils in several grades in a number of schools. He found that the results varied greatly from school to school, the capacity in each school appearing consistently in all of its grades. By comparing these data with the amount of time given to arithmetic in the school programs, the size of the

⁵ J. M. Rice, "Educational Research: A Test in Arithmetic," *The Forum*, Vol. XXXIV (1902), pp. 281 ff.

classes, the age of the pupils, and the conditions of their home life, it was shown that none of these factors was responsible for the differences in arithmetical ability. It is hence suggested that variations in methods of teaching and supervision are perhaps the responsible factors. The influence of these factors may be measured in the same experimental way.

By a somewhat similar procedure Kirby* was able to show that, in the case of practice in arithmetic under ordinary school conditions, "the greatest gains were made by the groups which had their practice in the shortest periods." Thirty-nine classes, comprising in all 1,350 school children, served as subjects of these experiments, practicing in addition and division. In the case of addition all classes practiced for the same total time, 75 minutes. But this total time was divided and distributed in different ways with different groups. In all cases there were an initial and a final period, of 15 minutes each. The intervening 45 minutes of practice were distributed in four different ways, over different periods of time. One group had two periods of 22.5 minutes, another, three periods of 15 minutes, another, seven 6-minute periods and one 3-minute period, and the fourth 21 2-minute periods and one 3-minute period. In these groups, then, the intervening practice periods are of different length but amount to the same total time. In the case of division three groups practiced for 60 minutes. In all cases there were an initial and a final period of 10 minutes, the intervening periods being broken up into smaller periods of 20 minutes, 10 minutes and 2 minutes in the three groups, respectively.

The results of these experiments were as follows: In addition the gains from practice in 22.5 minute, 15 minute, 6 minute and 2 minute periods, respectively, were in the rela-

*T. J. Kirby, "Practice in the Case of School Children" (Teachers College, Columbia University, Publications, 1913).

tion 100, 121, 101 and 146.5. In division, the gains from practice in 20 minute, 10 minute and 2 minute periods, respectively, were in the relation 100, 110.5 and 177. These experiments were made from the practical point of view, from which it is immaterial how much the children study the matter that is being practiced outside of school hours. If we assume that they did so as much when the practice periods were distributed in many short periods as when they were distributed in few long periods, the results show that the shorter practice periods, especially the 2-minute periods, are much more advantageous.

THE RECOGNITION OF INDIVIDUAL DIFFERENCES IN EDUCATION

The knowledge of the ways in which individuals differ from each other, the degrees and directions of this variation, its causes and educational consequences is the foundation on which must be based all discipline, all differentiation of studies, all guidance and advice, all appointment and control. Especially characteristic of modern education is the study of individual differences in mental constitution, and the attempt to recognize these differences in classification, discipline and teaching. The traditional classification on the basis of physical age has given way to the recognition of mental levels. The differences in intellect and achievement that are typical of public-school grades and the relation between intellect and achievement are well illustrated in a case cited by Terman.⁷ Two classes from the fifth grade of a school system were studied intensively, and yielded the data shown in Table LV.

A child in the 140 I.Q. class should be able to attain marked success in one of the learned professions, but all the refinements of educational method are incapable of bringing a child of 60

⁷L. M. Terman, *The Intelligence of School Children* (Houghton Mifflin Co., New York, 1919), Chap. 5.

TABLE LV

INDIVIDUAL DIFFERENCES AMONG FIFTH GRADE STUDENTS

	Class A	Class B
Number of Students	41	38
Range of Chronological Age.	9.5 to 14 years	9.5 to 15 years
Range of Mental Age	10.0 to 15 years	7.8 to 14 years
Range of I.Q.	78 to 148 years	60 to 144 years

I.Q. to the level of seventh-grade ability. If both should remain in school, the former will be winning Phi Beta Kappa honors at college graduation, while the latter is still struggling with simple fractions or long division. The difference between 140 I.Q. and 60 I.Q. is 80 points. The difference between an average child and a high grade idiot, who will never develop beyond three years, is also about 80 points. In the former case, we do not think of the contrast as being so great because our perception of intellectual differences in the upper ranges is much less acute than for the lower ranges.

Two students in class A are capable of doing eighth grade work, one-fourth of them are ready for the seventh grade and one-half for the sixth grade. On the other hand, there are in class A eight pupils who are adapted for only fourth grade work. In class B there are 14 pupils capable of only fourth grade work, seven who should be in third grade, and one who probably belongs in second grade. These differences among students in the same class, making uniform instruction impossible, are paralleled by the differences found between the classes that are supposed to attain the same standards of achievement. The median I. Q. of class A is 108, and that of Class B is 91. Class A has 44 per cent of cases with an I. Q. above 110, while class B has only 10 per cent; class A has 19 per cent of the I. Q.'s below 90, while class B has 44 per cent. The achievement of the two classes, measured by standardized educational tests, shows equally striking differences. In addition, subtraction, multiplication

and division, and in reasoning the average difference is more than two school grades, while differences in spelling are considerably less.

Every teacher of experience can narrate, from earlier years of work, case after case in which labor, worry and sacrifice were entailed by the failure to recognize, in the "problem," a mentally defective boy, an adolescent girl, a neurotic parent, a paranoid superintendent or a senile member of the board. Many a microcephalic child, with his irremediable mental limitations, has caused the teacher sleepless nights, and many a pupil has in turn been seriously impeded through life because of the principal's failure to understand the true nature of a speech defect, a choreic tic, or a proclivity for day-dreaming.

Modern psychological experiments must be taken into account in any effort to adjust the educational program to such differences as may be due to race and ancestry. Racial differences which have been measured, thus far, are difficult to interpret, but they do suggest that differences in educational treatment are advisable. Ferguson,⁸ who studied the Negro and white children of three southern cities, concludes that "it does not seem possible to raise the scholastic attainment of the Negro to an equality with that of the white. It is probable that no expenditure of time or money would accomplish this end, since education cannot create mental power, but can only develop that which is innate." It is his opinion that the lack of capacity for abstract thought, coupled with a higher capability for sensory and motor development, points to some form of industrial education for the Negro. Such tentative conclusions as these, and somewhat similar ones concerning other national groups, indicate that there is an important educational problem to be solved.

⁸G. O. Ferguson, "The Psychology of the Negro," *Archives of Psychology*, No. 36 (1916), p. 123.

The provision of equal and identical educational and professional opportunity and encouragement now rapidly being extended to all individuals regardless of sex is in part due to, and throughout justified by, the demonstrations of experimental science that in no measurable respect, whether in type, degree or variability, is mental capacity originally conditioned by the biological accident of sex.

In the modern school not only are efforts made to adjust the curriculum and the extra-academic activities to the individual differences of the pupils, but special classes and methods are adapted to the particular needs of the feeble-minded, the backward, the precocious, the normal, the sick, the crippled, the blind and the deaf. Even special classes for those to whom spelling or arithmetic present special difficulties are by no means uncommon. The poor speller, the truant, the blockhead, the prodigy, instead of being sources of worry, prayer and administrative despair, are fast becoming the subject-matter of zealous and scientific research.⁹

THE MEASUREMENT OF EDUCATIONAL PRODUCTS

The derivation of scales for the measurement of intellectual level was originally prompted by the urgent need for such measures in school supervision and administration. In the comparative experiments of pedagogy it is desirable, if possible, to select the pupils to be tested in such a way that groups of equal native capacity be submitted to the conditions of the experiment. In the consideration of an individual pupil and his educational difficulties it is first of all important to know whether he brings a normal intelli-

⁹ See L. S. Hollingworth, *Special Talents and Defects* (The Macmillan Co., New York, 1923) for a general survey of these questions; and *The Psychology of Special Disability in Spelling*, Teachers College, Columbia University Publications, 1918, for an intensive study of a single disability.

gence to bear on these difficulties or whether he is originally inferior or superior in mental equipment. His disposition and treatment, his classification and direction must be random unless these facts be ascertainable. Scales of mental measurement make possible the prediction, long beforehand, of the most probable quality of the pupil's later academic and vocational achievement, thus in many instances saving waste to society, accident to industry, expense and worry to parents, and fruitless effort to teachers and supervisors. The individualization of pedagogy is made more completely possible by the construction and elaboration, by psychological investigators, of the various types of scales for mental measurement and intellectual diagnosis. Through the intelligent use of these products of the laboratory the selective work which the test of the school curriculum has traditionally required years to accomplish may often be effected in a single hour.

The most active interest at present resides in the prediction of school success on the basis of intellectual status determined by tests. Some notion of the possible future scope of such prediction was given in Chapter VII, and a more detailed examination of the intelligence tests as a vocational index has been presented in Chapter XVI. Relying upon the measured constancy of the I. Q., Terman¹⁰ makes predictions of school achievement, as illustrated in the following samples :

1. A child of 60 I. Q. will never be able to do good work above the third or fourth grade.
2. A child of 70 I. Q. will be able to attain fifth grade and may do average work there.
3. A child of 80 I. Q. will be able to do average work in the seventh grade.
4. A child of 90 I. Q. can progress through eight grades,

¹⁰ L. M. Terman, *The Intelligence of School Children* (Houghton Mifflin Co., New York, 1919).

but with the expectation of a half or a full year retardation. Persistency may carry such a person through high school but with difficulty.

Growing out of the development of scales for the measurement of general mental level and closely related to this movement in method and purpose, is the recent work on the derivation of scales for the measurement of special school products. By methods originally devised for the measurement of experiences and materials whose values could be serially arranged but not quantitatively expressed, the qualities of such products as handwriting, literary composition, drawing, spelling, arithmetic, reading, language ability, mechanical construction, etc., can now be compared. Such comparison enables the formulation of scales for the measurement of these school products, which may be used to advantage in the elementary subjects, in the place of the traditional "examination" with its manifest unreliabilities in type of question, relative difficulty of answer and solution, assignment of grades, and standards of achievement.

By the use of such scales the pupil himself is enabled to observe in a definite way the progress of his learning. The teacher is enabled to check up her methods of instruction and drill, since such scales make possible direct comparison of one class with another. The practical impossibility of making such comparisons without the use of standardized measuring scales has been demonstrated many times. As a concrete illustration, the grades given to the same geometry paper by 116 teachers are shown in Figure 47.¹¹ With the passing grade set at 75, forty-seven teachers gave the paper a passing grade and sixty-nine did not. Two teachers gave it a grade above 90 and one gave it a grade below 30.

The supervisor may from time to time determine in exact ways the relative effectiveness of the instruction of different

¹¹ See D. Starch, *Educational Measurements* (The Macmillan Co., New York, 1917), p. 6.

teachers, so far as the value of this instruction depends on the character of the children's work. Standards of performance may be laid down for the various school grades and uniformity of practice and demand developed in different parts of the school system. Statements of individual capacity in school subjects may assume quantitative form, and the assignment of grades and marks loses much of its variability and unreliability. The work of one school system may be compared with another, and the work of surveys thus extended beyond the consideration of buildings and

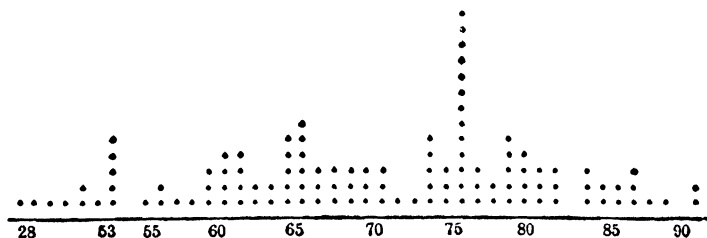


FIG. 47. INACCURACY OF SCHOOL MARKS

grounds, ventilation and salaries, so as to include the actual psychological products of the classroom.¹²

Among the product scales that have been devised for such educational purposes the following are especially well known: Woody Arithmetic Scale, Curtis Arithmetic Tests, Thorndike Handwriting, Reading and Drawing Scales, Hillegas and Harvard-Newton Composition Scales, Ayres Penmanship and Spelling Scales, Trabue Language Scales, and Kelly Reading Scale.¹³ The student of applied psy-

¹² The technique of the construction of such product measuring scales is described in detail in W. A. McCall, *How to Measure in Education* (The Macmillan Co., New York, 1923).

¹³ Many of these scales are illustrated and described in W. S. Monroe, J. C. DeVoss and F. J. Kelly, *Educational Tests and Measurements* (Houghton Mifflin Co., New York, 1917). Materials of this sort may be purchased from one or more of the following

chology should be interested in becoming acquainted with one or more of these instruments, with the technique of their formulation and application and the nature of their results. Such scales are now being widely employed in the classroom, in educational research and in school surveys, and constitute perhaps the most material contribution of psychological technique to education.

sources: Bureau of Publications, Teachers College, Columbia University, N. Y.; Public School Publishing Company, Bloomington, Ill.; World Book Company, Yonkers, N. Y.; C. H. Stoelting Company, Chicago, Ill.

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