The Fundamentals of
Human Motivation

By

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TO

MY WIFE

Whose Happiness is Conditioned
upon the Welfare of Other People

PREFACE

The present book is intended to be a systematic treatment of the facts and problems of human motivation. It attempts to answer certain questions which are of the utmost practical importance in human life, but which have not been adequately treated in available psychological texts. Why do people behave and feel as they do? What are the foundations of impulse, desire, emotion, purpose and habit? How can these processes be controlled? These topics have been discussed in many books and articles, in a fragmentary or a popular way, but I am not aware of the existence of a comprehensive treatment which endeavors to present all of the pertinent facts and theories in a systematic manner. Dr. Morton Prince once said to me that "the problem of motivation is the only important one in human life," and yet I believe that the present book is the first to incorporate the word, motivation, in its title.

The following questions, discussed in the ensuing pages, should be of interest to any conscious human being: (1) our inborn tendencies to action, (2) the means by which we learn, (3) the basis of "pleasure and pain" and the part which they play in learning, (4) the foundations of "happiness" in general, (5) the nature and operation of "instincts," such as that of sex, (6) the physiological meaning of the Freudian "complex," (7) the nature and foundations of emotional experience, (8) the explanation of typical modern interests: automobiles, radio, and the like, (9) suggestions towards a scientific treatment of the problems of ethics. In dealing with these varied subjects, I have endeavored to summarize all significant available facts and theories, and yet to combine them into a doctrine which has some new aspects, and gives unity to a discussion which might otherwise be confusing. This doctrine is called *the theory of retroflex action.*[1] It has the merit, not only of explaining a very considerable number of hitherto puzzling facts, but of agreeing with more of the older theories than it contradicts.

In order to achieve a comprehensive treatment of the problems of motivation, it is necessary to be tolerant in dealing with certain seemingly divergent tendencies in modern psychology. One must be sympathetically inclined towards the purely physical line of thought which is represented by the behavioristic school, and yet at the same time, take due cognizance of such ultra-psychical views as psychoanalysis. The discoveries of modern analytical physiology must not be neglected, and we should draw on the results of laboratory introspective psychology wherever possible. The problems of motivation particularly invite a balanced discussion of both the bodily and the mental factors in life, as well as a study of the relationships which exist between these factors. Consequently it has seemed wisest, in the present book, to avoid extremes of modern doctrine, and to treat the subject by the traditional psychophysical method. It happens that this is the method which seems to me to be capable of revealing the greatest amount of truth, in any field of psychological investigation.

No pretense is made that this book is a popular discussion. It purports, rather, to be a scientific analysis of the motivational problem, although necessarily tentative and schematic in scope. There seems to be little advantage, at the present time, in adding another superficial treatment of these problems to the long list of writings which already exist. However, I have endeavored to make the book self-explanatory, so that any educated reader should have no serious difficulty in following the argument, even if he has not been specially trained in psychology. In order to assist such readers, a glossary of technical terms has been appended.

The book should be of interest to students of the social sciences, as well as to all who are concerned with the control of human action and feeling. Sociologists have always felt the need of a motivational psychology. Up to the time when McDougall's *Introduction to Social Psychology* first appeared, they usually felt compelled to invent such a psychology for themselves. McDougall wrote especially for the benefit of the social sciences. I have written with a view to filling what seems to me to be a gap in psychology as a pure science; but the ultimate justification must lie in applications, which I hope will be made by sociologists, economists, educators, and all kinds of workers in society who need a motivational psychology as a basis for sound thinking and action.

In the matter of credits, I wish to acknowledge my indebtedness to my colleague, Dr. Prince, for a great deal of inspiration to thought along the lines of motivational psychology. I must also thank my former colleague, Professor William McDougall, for the stimulus which is provided by his numerous writings in this field of investigation. Although I have found it necessary to take issue with his views in many respects, I believe that we are fundamentally more in agreement than in disagreement. I shall consider it the highest of compliments if he will criticize my doctrines as freely as I have dealt with his. I also wish to express my thanks to Dr. W. B. Cannon for reading a portion of the manuscript, to Mr. A. D. Fuller, Jr., for assistance with the proof, and to my wife for help in the preparation of the reference list and index.

L. T. Troland

Harvard University,
June, 1928.

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Human Motivation

Chapter I

The Problem of Motivation

1. *The Paucity of Motivational Psychologies*

When the layman thinks of psychology, he is usually interested in the nature and interplay of human *motives.* He looks to psychology for an explanation of some peculiarity in the behavior of a fellow man, or in his own desires and impulses. He believes that psychology should tell him why people act as they do, and how their tendencies of action can be modified in desirable directions. As a business man, he wishes to know how to play on the motives of other men so that they will purchase his goods or services. In the family relation, he needs instruction in maintaining harmony of action or feeling between the various members of the group, and the proper development of personality in his children. In drama and literature, psychology seems to stand for the study of motives, and the manner in which they express themselves in the deeds which men do.

Anyone who opens a modern text-book of psychology with this interest in mind is doomed to sore disappointment. The first half of the book is, ordinarily, devoted to a mass of uninteresting details regarding "sensations." Just why sensation should be uninteresting to the layman is an interesting problem in motivation, but the fact remains that he is satisfied to see and hear and feel without experiencing any curiosity as to how these things are accomplished for him. The psychology book then goes on to consider such problems as perception, memory, imagination, association, conception, judgment, reasoning, and the self, all of which seem to be very abstract and foreign to the interest of everyday life. There are usually a few pages on will, emotion, feeling and the like, which have a bearing upon the problems that interest the lay reader, but ordinarily give him no specific answers to the questions which he has in mind.

However, if our reader chances to pick up a volume dealing with psychological problems from the so-called "behavioristic" standpoint, he may be somewhat more encouraged. Here he may find psychology defined as the science which explains and predicts the behavior of men and animals. Here, also, he will find that the chapter headings of the conventional text-book are frowned upon, and that very little is said about sensation, perception, feeling and similar topics. Instead, the book deals with receptors, nerve-paths, reflexes, instincts, habits, and the "integrative action of the nervous system." But the lay reader is likely to become bewildered by the technicalities of this discussion, and to feel that, although the behaviorist formulates the question correctly, he does not give a satisfactory answer.

2. *Motivation as a Psychophysiological Problem*

It is a paradox of the problem of motivation, as it is ordinarily stated, that we seek a mental explanation of a physical event. "Why did he act that way?" The behavior is physiological and can be described in material terms, without any reference to mind. The behavior is constituted by certain movements of a mass of matter called the organism or living body. But we are not satisfied to be told that the explanation of these movements is exclusively physical. It is not enough that the eye should be stimulated by light, that a nerve impulse should thereby be aroused and that, consequently, the muscles contract thus and so. When we question the *motive* of the behavior, we are asking for the thoughts and desires of the individual, and these are mental, and beyond the behaviorist's scheme of things.

Evidently, the motivational problem is *psychophysiological.* It involves simultaneously the response processes of the nervous system, and the mental processes which accompany them. Both the psychical and the physical factors in the situation must be viewed in intimate correlation, in order that a satisfactory account should be given of what is happening. In a sense, the problem of motivation involves all of psychology from all general points of view, but with emphasis not so much upon structure as upon operation. It is "dynamic psychology," in Woodworth's sense, rather than "structural psychology," in Titchener's sense; but it can neither be narrowly behavioristic, nor strictly introspective, and succeed.

The present book purports to be a complete treatment of the problems and facts of motivation by the psychophysiological method. We shall regard the data of physiology and of introspective psychology as of coördinate importance, and we shall endeavor to state principles which shall be of sufficient comprehensiveness to embrace the behavioristic and the introspectionistic ideas, as well as those of popular thinking.

3. *Psychological and Physiological Foundations*

However, we must recognize at the outset, that the scientific account of the basis of human action may not prove entirely palatable to the lay consumer. In the first place, the psychologist will explain a great many things which the layman does not ask to have explained, even in the domain of motives. Ordinarily, we question motives only when the behavior of the individual is, to some extent, unusual. Habits of a conventional kind, such as eating, sleeping, or playing golf, are taken for granted; but any infraction of convention or law, such as murder, requires a deep study of motives. Nevertheless, the psychologist will be compelled to explain the commonest forms of behavior first, just because they are more universal, and then consider departures from these types of action as special cases when the more general tendencies have been determined.

Furthermore, the methods of physiological psychology will compel us to consider the mechanisms of the nervous and muscular systems of the body as important factors in motivation. The account cannot be given completely in these terms, but it cannot be complete without them. We can appreciate this fact at once by considering that all behavior is controlled at least *through* the neuromuscular mechanism, if not *by* it. We know that the body stands or moves only because the nerves are energizing it in a definite manner. What energizes the nerves may be the fundamental question of motivation, but we must approach the answer via the nervous system. Hence, it will be one of our first tasks to consider the nature and operation of nervous forces. We cannot do this without studying, also, the structure of the nervous system, since the forces are limited and directed by the structures.

We shall also be compelled to consider in detail some of the ideas which result from the introspective analysis of consciousness, or the exclusively mental side of the situation. In doing this, we shall credit the conventional psychology with having made some very important and essential distinctions. We shall not confine ourselves, however, to purely introspective data on the subjective plane, since the more hypothetical ideas concerning the subconscious, as advocated by Freud, Prince and others, will prove to be valuable instruments of thought. Only by arriving at precise notions regarding the psychical part of the system can we hope to construct intelligible explanations which link the mental with the physiological, and yield the kind of an answer which the question of motivation requires.

Perhaps the most important phase of our problem lies in the formulation of these psychophysical linkages. Here we are logically bridging the greatest gap in the universe, that between consciousness and matter. On the one hand, we find the organism as it is conceived by modern biology, and, on the other, the radically different phenomena which we call psychical. But, if we believe that motives can be mental, there must be some reliable connection between these two distinct sets of facts. We must make our conception of this connection definite. For example, if we believe that the mental phenomenon which we call pleasure is a factor in the understanding of behavior, we should inquire as to just what feature of brain activity is associated with pleasure, and what the formula for this association may be.

There are four general standpoints from which we can approach the facts of motivation. They are those of (1) popular thought, (2) physiology, (3) introspection, and (4) psychophysiology. Let us consider, in a preliminary manner, how the problem can be stated from these different points of view.

4. *Popular Motivational Ideas*

From the common sense angle, we usually ask concerning a person's behavior: "*Why* did you do that?" or, "*What* did you do that *for?*" "Why" and "what for" may sometimes be used interchangeably, but it is easy to see a plausible distinction between them, which is that between *reason* and *purpose*. The question, "why?" can be answered by assigning a reason, whereas "what for?" inquires into a purpose. Reasons, in this sense, are usually circumstances of some sort external to the individual, and constitute conditions under which the purpose must operate. For example, if the question is: "Why are you painting your house?" the reason may be given in the answer: "Because it looks shabby." Purposes, on the other hand, are internal characteristics of the acting individual. If the query is: "What are you painting your house for?" the answer may be: "Because I like to see it look well." Reason and purpose together constitute the motive of the given form of behavior.

As conceived by the layman, reasons are supposed to be features of the physical world, sometimes including his own body. But in order to become reasons they must be sensed, perceived, or, at least, be believed in. Thus, they become psychological. Only too frequently, reasons are delusions, because they do not correspond to adequate facts in the physical system. Nevertheless, they must be regarded by the individual as having such a correspondence, in order to be effective. Purposes are always conceived as being mental in character, having the nature of thoughts or desires. Habits, or other mechanical tendencies of the nervous system, are not ordinarily considered to be purposes. Thus, when the layman inquires into a motive, he wishes to know what the individual had in his mind as a desired end, and how the supposed environment affected the behavior which was necessary in order to realize this end. This way of conceiving the situation is too simple to lead to any real insight into the dynamics of action.

5. *Motivation in the Nervous System*

From the *physiological* standpoint we view the living organism, human or other than human, as a vastly complex aggregation of electrical particles having a definite pattern and process in space and time. All subjective conceptions, such as those of sensation, thought, feeling and the like, are ruled out. The scheme is rigidly material, and its processes must be explained in a strictly physical fashion. Ultimately, all structures and activities depend upon the laws of electrostatics and electrodynamics, alone; but physiologists do not ordinarily dig so deeply as this. They are content to formulate what happens in terms of more complex and less ultimate units, such as those of muscle or nerve cell. Yet, even the crudest of physiologists does not admit psychological notions into his explanations. This is true even of behaviorists—who are perhaps the crudest of all—although they choose to employ the word, psychology, to denote certain wholly physiological studies.

When we view the behavior of an organism in the light of modern physiology, we recognize, at once, that our primary concern is with the functions of the nervous system.

If we wish a physiological explanation, we must seek it in the structure and operation of the nerve-muscle apparatus. We must understand how this apparatus *works* as a machine, or as a physico-chemical arrangement. Motives, in this inquiry, will be physical sources of energy, or of control; motional rather than emotional agencies. The physiologist can immediately identify some of the prime movers in nervous activity. The typical nerve function is called *response;* and response consists of a sequence of events which begins with the operation of a stimulus, and comprises in order: a sense-organ process, an inwardly transmitted nerve impulse, a central or brain process, an outwardly transmitted current, and a muscular adjustment which controls and, essentially constitutes, the organism's *reaction* to the stimulus. In this scheme, the stimulus appears as a primary dynamic agency, but the special sensitiveness of the nervous system, which permits the stimulus to touch off a certain kind of response, is, also, of the utmost significance.

6. *Response Specificity*

If we study response in a general way, without inquiring into all of the details by which it is effected, we find that there is a strong tendency for the character of the reaction to be determined by the nature of the stimulus. We can control the behavior of men and animals to a considerable extent by regulating the forces which act upon their sense-organs. The relation of the reaction to the stimulus shows much greater constancy in a single individual, from time to time, than it does in different individuals of the same species. Yet there is some uniformity, even between different species. Hence, we are led to formulate a principle of *specificity of response,* according to which, the nature of the reaction can be inferred from that of the stimulus. It is evident, however, that this inference is not purely logical, since there is nothing inherent in the character of the stimulus itself which enforces the reaction; but the inference is, rather, based upon empirical findings and reveals a specific structure, or tendency of the nerve mechanism, which the stimulus sets off.

This principle of response specificity is the one which we customarily rely upon to govern the behavior of our associates, insofar as we make any attempt to accomplish such a result. Nevertheless, it is notoriously unreliable in the hands of amateurs. Men, and even lower animals, do not seem to follow given stimuli with mechanical precision. Part of the reason for this seeming unreliability of the principle is to be found in a failure to discover and to control all of the stimuli which are effective in particular instances. For example, it is common for all animals to respond to the presence of food by eating it; and the reason why this does not always occur is that the complete stimulus for this reaction includes an empty stomach. On some occasions when the reaction fails, there is an unnoticed interfering stimulus, such as fever or fear. Another explanation of apparent failure of the principle is to be found in a change in the response system itself between two cases. As an example, we may consider the rejection of a once favorite food as a consequence of the doctor's orders, or some other disagreeable and inhibiting association.

7. *Nervous Mechanisms*

If we accept the principle of response specificity for what it may be worth, we may proceed with our motivation inquiry by searching out the mechanism which underlies the principle in all cases where it applies. We can, also, investigate the causes of its failure in certain instances. In starting upon this investigation, we notice, first, that the nervous system is a *conducting* network, and that the stimulus is linked with the reaction through the medium of nerve impulses or currents which are propagated through this network. The mechanism of response specificity must be found in the details of this conduction process. Accordingly, we must begin by learning the nature and principles of nervous conduction. Furthermore, the process will obviously be influenced by the *structure* of the nervous system, either gross or microscopic, and whether physical or chemical, so that we cannot neglect to consider these aspects of the operating mechanism.

Eventually, we shall decide that the explanation for an animal's specific reaction to a given stimulus lies in the recognized nature, and inevitable interaction of these various factors in the situation. Given a nerve arrangement constituted thus and so, it must be set off by a certain stimulus, and, when set off, it must lead to the reaction which is seen to follow. The necessities of the process will appear to be similar to those of the movement of an automobile when the motor is started, and the gears and clutch are engaged. When we have completely envisaged this mechanical system, we shall be able to see whether there is probably any outside guiding agency, as there usually is in the case of an automobile, or, whether the mechanism is entirely automatic—which is easily conceivable.

8. *The Origin of Nervous Mechanisms*

However, such an understanding of the nervous mechanism will still leave some purely physical questions unanswered. We may be willing to accept the general laws of the nerve impulse as fundamental principles, but special nervous response structures require further explanations of a genetic sort. If Jones reacts differently from Brown, to identical stimuli, it is because his nervous system has a different constitution. But "how did it get that way"? To answer this question we must know the *history* of the particular nervous organization in question. This history embraces influences of two sorts, those which first formed the system in "ontogenetic development," which we call *hereditary,* and those which have molded it from the outside, which we call *environmental.* Some response mechanisms follow wholly from the action of ontogenetic forces, whereas others have been produced by external influences. We shall find it of especial importance to separate the consequences of heredity from those of environment, and to understand, clearly, how these two factors coöperate in creating the given nervous scheme.

In this study, we shall encounter the familiar but very interesting problem as to the extent and manner in which *instincts* determine human or animal behavior. We shall also be obliged to consider the laws of learning and the principles of education, insofar as they bear upon the impressibility of the nervous system. It will be of particular importance to discover how innate mechanisms are modified by individual "experience," and what the hereditary conditions of learning may be. The manner of conduction by the nerves from stimulus to reaction—which determines the response specificity—must be largely a matter of the kinds of *connections* which exist between the in-leading and out-going nerve conductors. Hence, we wish to know what connections are established ontogenetically, and how connections can be made or broken as a result of individual "experience."

9. *Motivation in Consciousness*

We have noted above, that, as a rule, when we ask for a motive, we are thinking of something mental, rather than purely physiological or physical in nature, in spite of the fact that the effect which has to be explained is the behavior of an organism. Now it is highly probable that the physiologist will find it possible to complete his explanation of behavior without bringing in any non-physical or mental factors. In other words, the common sense belief that the mind actually guides or energizes the body is almost certainly erroneous. The human organism can be considered successfully as an automaton. Not only so, but if the physiologist were forced to introduce mental factors into his accounts, he would be in the embarrassing situation of mixing two incompatible kinds of conceptions. He would have the task on his hands of showing how feelings can move atoms.

All this, however, has no bearing upon the question as to the *existence* of feeling as an accompaniment of the atomic movements. The physiologist's account may be complete within itself, but it is not a complete account. There is a consciousness which correlates with the nervous activities, and a comprehensive doctrine of motivation must deal with the subjective as well as with the objective facts. The original conception of the problem of motivation involves the mental side, as much as it does the bodily side of the total situation. If we consider the behavior of another person, we are apt to think about it objectively; but we have a subjective view of our *own* actions, and believe that we know our own motives as mental facts.

As a matter of fact, the problem of motivation can be stated without any actual reference to physiological factors or events. This is proven, very clearly, by a study of *dreams*. Here we find a very intense play of motivational forces, with no obvious physiological accompaniments. Of course, something is going on in the nervous system which corresponds to the dream, and sometimes pertinent muscular expressions of the dream state occur; but, as a rule, these are of minor importance, and there is no observer to note them. There is plenty of action in many dreams, it is true, but it is essentially imaginary, and must be regarded as a mental representation without adequate correspondence with physical events. Thus, in dreams, we are compelled to deal with the problem of motives almost exclusively from an introspective standpoint.

10. *Desires and Purposes*

The dream consciousness is not essentially different from that of waking life. The principal distinction lies in the superior truthfulness of the waking consciousness in its relation to the physical world which the consciousness purports to represent. Accordingly, the laws of the waking mind are to a large extent those of the material world, whereas the dream consciousness makes its own laws and molds the entire presentation to suit subjective tendencies. These mental tendencies, which seem to control the course of consciousness and action, may be characterized as *desires* or *appetites.* More popularly, we call them *wishes* or *wants.* When we view our own behavior from a subjective standpoint, we find it to be dominated by these *appetitional* agencies. Everything that we do seems to be in the interests of an unfulfilled wish.

The question as to the nature of wishes, and how they operate in consciousness, is the central problem in motivation on the psychological side. As a rule, a desire seems to consist of a vague imaginal representation of something toward the clearer and more intense realization of which consciousness tends to move. Images of action cluster around it as instruments to its fulfillment. The desiderative image is strongly pleasant or unpleasant, and the course of the consciousness is towards increased pleasure or decreased displeasure. Unpleasant desires are usually directed towards the negation of, or escape from, some present condition which is definitely perceived, or else believed to be real. Thus we desire to be rid of bodily pain or of a mortgage on our property; or, on the pleasant side, we may desire good-tasting food, or wealth.

When desires become sufficiently complex, definite, or sophisticated, we call them *purposes.* Purposes are also characterized, as a rule, by considerable permanence, and by less feeling than are more primitive desires. Insofar as purposes appear in consciousness, they are representations of a goal or an "end." Purposes usually have very complicated associations with images which represent various kinds of action capable of subserving them. Ordinarily, we think of a man's purposes as being the most important factors in his motivational equipment, but there is a great deal to be learned concerning their psychological nature and operation.

11. *Emotion and Feeling*

The phenomena of *emotion* are closely related to those of desire and purpose. Emotional processes appear when the fortunes of some desire or purpose are powerfully affected, whether for better or or worse. Emotions are nearly always accompanied by profound modifications of behavior, and frequently are followed by important changes in the individual's system of purposes. Psychologists have taken a considerable amount of interest in emotional states; and theories of the emotions must form a significant part of a comprehensive discussion of motivation.

Another general psychological topic, which will inevitably concern us to a great extent, is that of "pleasure and pain," or, more strictly, *pleasantness and unpleasantness*. Without committing ourselves at the moment to a definitely *hedonistic* theory of motivation, we must, nevertheless, recognize the fact that feeling is closely bound up with the operation of desires and purposes. There can be no mistake about the existence of a general tendency of the mind to turn toward the pleasant and away from the unpleasant, although the traditional hedonistic doctrines have certainly missed the whole truth. It will be part of our task to review these doctrines in the light of the facts, and to arrive at a new conclusion regarding this ancient philosophical question.

12. *The Subconscious*

In general, we shall find that although there are many essential motivational factors in consciousness, available to introspection, a theory of motivation which confines itself to such data is unsatisfactory, because fragmentary. Consciousness acts as if it were a section of a much larger system, most of which is hidden from view. In an effort to piece out the picture, we may have recourse to ideas about the subconscious, or the unconscious minds. In doing this we shall be running the risk which goes with purely hypothetical thinking because we have no adequate method of proving the existence of such a system as the subconscious. Nevertheless, we cannot neglect to consider such teachings as those of Freud and other psychiatrists, since their theories, perhaps, have done more to found a scientific discussion of motivation than any other contribution to the subject. It is likely that we shall be able to relieve the psychoanalytic doctrines of some of their vagueness, and tie them up with facts in a manner more satisfactory than has thus far been achieved.

13. *Relations of Consciousness to Response*

However, when we are seeking to supplement the introspective data, we are on the surest ground if we turn back to physiological considerations. But, in doing so, we adopt a new attitude, which is that of determining the actual relationships between the mental and the bodily factors, apart from any prejudice regarding the part played by one in the affairs of the other. From the standpoint of *psychophysiology,* mental occurrences are *correlated* with certain processes in the brain, but there is no interaction between the two. Given a certain conscious condition, there must always be a fixed corresponding brain condition, but this is the sum-total of our knowledge concerning the relationship. It follows a reliable law, but we do not know why. No doubt this view—psychophysical parallelism—is intellectually very unsatisfactory, but it provides us with the surest ground for our thinking in our present state of philosophical enlightenment.

One of the first questions which we must consider from this psychophysiological standpoint relates to the manner in which action or behavior is represented in consciousness. It is necessary to know this manner of representation if we are to trace the psychophysical linkage between what the individual is doing, and the purposes which he entertains concomitantly in his consciousness. In ascertaining such a linkage we shall be coming as nearly as possible to an answer to the common sense question of motives: What is the purpose which is associated with this given behavior? Now, in a general way, the whole of consciousness has "motor significance," or stands in an intimate relationship to action. This is expressed in the so-called "motor theory of consciousness," as advocated by William James, and is due to the fact that consciousness in its entirety is correlated with the central, or brain stage in the process of response. Indeed, consciousness acts *as if* it were identical with certain aspects of the brain process. We know that it is not actually thus identical because it is so very different in nature from the brain activity, and because it is not located in the brain.

14. *The Problem of the Action Consciousness*

In spite of the general "motor significance" of the whole of consciousness, there are some special portions of it which we can pick out as being peculiarly related to behavior. First, among these, we must consider what is known as *kinaesthesis,* or sensations of movement. These are components of every normal consciousness which are referred to the stimulation of the sense-organs in the muscles, tendons and joints, and which apprise us of the exact positions and motions of the various members, and of the body as a whole. These sensations furnish the basis for definite motor *perceptions.* When the organism is not actually reacting in a given fashion, it is still possible to represent this reaction in consciousness by means of *kinaesthetic images* which correspond in form with the perceptions in question, but which are lacking in intensity or vividness. Usually, such kinaesthetic images are present in consciousness as premonitions of specific kinds of action, being filled out into perceptual form when the action takes place.

We also commonly find a clear representation in consciousness of the stimulus which initiates the response, and with respect to which the reaction is specific (*vide supra*). This simply means, in common sense terms, that we see or hear the thing which has aroused our volition. Sometimes we only imagine it, but there is still a conscious representation. Usually, consciousness seems to reveal the logical relationship of this representation to the ensuing behavior, in the light of a purpose which is also present and operative. We see a person approaching to whom we owe a bill, and we turn aside to avoid him. This all seems very simple and clear, but it is full of detail and vagueness from the scientific standpoint.

What happens in consciousness just before we "turn aside," as in the above illustration? What, in general, are the critical conscious conditions of change in behavior? Common sense says it is "an act of will," but what is this? How does volition operate and follow from purpose and perception? Answers to these questions are essential to a complete understanding of the psychophysiology of motivation. In dealing with these questions we shall have to consider the ancient problem of the "freedom of the will," and to decide what form of "determinism" is demanded by the facts.

15. *Other Aspects*

One of the most important phases of our discussion has to do with the origin and development of the motivational factors which are inherent in the psychophysical organism. To a certain extent, we can trace the history of purposes by introspection or retrospection, but the results of such a study must be correlated with the facts regarding the genesis of specific reaction tendencies on the physiological side. In general, these two lines of development will show a psychophysical parallelism, and we shall do well to determine the exact nature of the parallel development. Here, indeed, we shall find the key to the entire system.

It is evident, from the above preliminary survey, that the discussion which is before us involves a very large number of different factors, and that the relationships between them are complex. The primary purpose of this book, however, is not to summarize an array of disconnected data, but to systematize all of the pertinent facts under a general theory. This theory must be new to some degree in order that it should register progress, but, on the other hand, it will be sufficiently old to permit it to embrace the essential truths of a large number of theories which are already well known.

Chapter II

A Review of Classical Doctrines

Before proceeding to develop the essential argument of this book, it seems advisable, as a further exposition of the problem and in preparation for its solution, to review extant ideas concerning motivation. Only a brief sketch of the salient theories will be possible, leaving the details to be incorporated in subsequent chapters.

16. *Animistic and Religious Doctrines*

The earliest of all philosophical theories is a motivational doctrine. This is the doctrine of animism,[3] which was an attempt to explain the behavior of men, animals and even inorganic objects. Animism furnishes the fundamental model for all popular ideas concerning motives. It sets forth a mental cause for physical effects. According to this view, activity in things is due to the presence of a *spirit* which functions as a carrier of motives. In primitive philosophies, the soul, or spirit, was conceived as a sort of air-body which acted as the common basis of motion and of feeling. The nature of the feeling in any given instance was supposed to determine that of the action. The feeling, in turn, depended upon the character of the spirit and external conditions to which it was subject. Spirits could usually be classified regarding their character as either "good" or "bad," i. e., as either friendly or hostile. Spirits exhibiting an indifferent motivation were of little interest to primitive man. Hence in the religious teachings which grew out of these early views we find a clear-cut dualism of good and evil.

Religion is a practical device for creating or for directing human motives in the interests of the social group. It comprises doctrines of a metaphysical as well as of a psychological nature, but throughout all religious teachings the theory of motives is the essential feature. The soul can defile itself and become "impure" by adopting motives which are evil. It can be converted and "saved" by eliminating such motives and replacing them by motives which are good. An incentive toward the good, and away from the evil, is provided by doctrines of future reward or punishment. Sometimes particularly unsocial behavior was explained in primitive religions as due to "possession by an evil spirit"; the proper soul was supposed to have been thrust out and replaced by a foreign and naturally evil one. The particular motives which have been classed as good or evil, respectively, have differed considerably in different religions, corresponding to differences in social necessity and tradition between peoples. Usually, selfish ambition and sex have been classed as evil, while devotion to the nation and family have been called good.

Nearly all religions, as they have developed, conceive man as having a dual nature. Good and bad motives are supposed to be present simultaneously, and to be in constant conflict. The Christian theology makes the good motives properties of the soul, whereas the bad ones emanate from the body or the "flesh." The teachings of Christ, himself, are directed primarily against the general tendency of all motives to be selfish, but without commending asceticism. Some oriental religions have carried to the extreme the abnegation of all natural impulses. Although we can form a catalogue of certain human motives from a study of religious texts, the latter do not seem to provide us with any very helpful analysis; but the notion of conflict which is of importance in more modern teachings is clearly present.

17. *Early Greek Views*

The Greek philosophers,[4] being interested in all things whatsoever, naturally concerned themselves to a considerable extent with motives. In a sense, their search for the "fusis," or the underlying cause of phenomena, may be regarded as a quest for the general motivating force of the universe. As a rule, the behavior of human beings was supposed to follow principles similar to those which governed the universe. Thus, in the teachings of Heraclitus, *fire* is regarded as the condition of all changes. It is also the source of human activity. According to Empedocles, the inert or material elements which form the body can only be moved by the action of cosmic forces which he calls "love" and "hate." Anaxagoras postulates a special mental, or highly refined material agency, called the "nous" which activates other things. The atomists, including Leucippus, Democritus and, later, the Epicureans, introduced and elaborated the doctrine of *hedonism,* or the "happiness theory." Although they regarded pleasure as being merely a motion of the more delicate types of atoms, nevertheless, they advocated it as the goal of all human activity. Feeling and desire, to Democritus, consisted in the vibration of fire atoms, but he said that true pleasure comes only with the more refined atomic motions which constitute thought or intellectual activity. Sense pleasures are really due to a cessation of unhappiness.

The Cyrenaics, represented by Aristippus, were also hedonists, but took a more sensuous view. They maintained that pleasure is the only good and the only goal of the will, all pleasures being alike in kind and merely momentary. Bodily pleasures were regarded as being greater than spiritual ones, although self-control was considered necessary to the greatest hedonic success. The Epicureans, as represented by Epicurus, combined the view of Democritian atomism and Cyrenaic hedonism. Their views are ably advocated by Lucretius and Horace. For them, philosophy was the scientific pursuit of "well-being," and immediate feelings of pleasure and pain were regarded as being the only motives to action. Epicurus tried to prove that "well-being" is nothing but pleasure, by showing, first, that pleasure and the avoidance of pain are the primary and natural ends at which all conscious beings aim and, second, that feeling is the actual standard by which we judge good and bad. All pleasures are equally good, but we cannot pursue them indiscriminately because the highest good is the pleasure of the whole life. Pleasure not only has intensity, but duration and relation to later affective states, which means that mental pleasures may sometimes be valued more highly than bodily ones. Virtue, according to the Epicureans, is merely the indispensable means for getting the greatest pleasure out of life.

18. *Greek Idealists*

Quite a different standpoint was taken by Socrates, Plato, Aristotle, the Cynics, and the Stoics, whose leading ideas were those of knowledge and virtue as goals in themselves. Socrates, as reported by Plato, seems convinced that only virtue, or right action, can make man happy. Moreover, knowledge of the nature of virtue is all that is required to motivate a man to good. The Cynics also regarded virtue as the only goal of action. Plato's [5] philosophy is concerned essentially with an investigation of the nature of different virtues, such as courage, justice, etc. Good acts, he believed, spring automatically from acquaintance with ideas or ideals. However, the soul is provided not only with a faculty of reason, which is in contact with the ideal world, but, also, with two "passionate parts," comprised of a "strong will activity" and "sensuous appetites." These "passionate parts" conflict with reason, and sometimes lead to ill behavior. The four cardinal virtues, according to Plato, are wisdom, fortitude (courageous will power), temperance and justice (a reasonable balance of the other virtues). Sensuous pleasure is not the goal of life, but, nevertheless, it is not considered by Plato to be an illusion.

Aristotle,[6] a disciple of Plato, defined the good as that toward which all things aim, and, according to him, it consists in carrying out our natural functions. The functions of man can be divided into the rational and the irrational, and virtuous conduct demands the rational regulation of irrational desires. Aristotle's doctrine of virtues throws much light upon his ideas as to fundamental human motives, since virtues involve a socially or biologically requisite adjustment of primitive action tendencies. This applies to theories of virtue in general; even to the ten commandments. According to Aristotle, virtues are always means between possible extremes, as, for example, courage, forming a balance between the extremes of rashness and cowardice. Aristotle explicitly admits that the pursuit of pleasure and the avoidance of pain form the strongest of all motives, but pleasure is not the only good. He identifies pleasure with "the unimpeded activity of the soul." He seems to agree with Plato and Socrates that he who knows what is right, cannot avoid doing it; clear knowledge takes possession of the will.

The Stoics [7] held it to be the cardinal principle of behavior that every being follows a primitive impulse towards self-preservation. Living in conformity to nature, is the essence of rationality in behavior. For them, pleasure was not the goal of action, but rather a result of the latter, the systematic quest for pleasure resulting in "confusion of the soul." They distinguished four primary emotions: fear, pain, pleasure and desire. Apathy is one of the prime virtues, but it involves a control of emotion, rather than an absence of the latter. The notion of a struggle between reason and emotion is prominent in Stoical teachings.

19. *Christian Ideas*

As the Greek philosophers fade into the historic past, the stage of occidental thought is dominated by the philosophy of the Christian church, and remains so until the dawn of the modern epoch. The views which are embodied in Christian ethics and theology involve a combination of primitive animistic ideas, and the more sophisticated notions derived from Greek philosophy. Christ, himself, evidently accepted the spirit theory and recognized the motives which are signalized in the ten commandments. The essence of his teaching is, of course, the idea and practice of brotherly love, or altruism, which is directed against the normal egoism or selfishness of natural motives. To motivate unselfishness, he appealed to heaven and hell, just as did the pre-Christian Jewish moralists.

The early Christian theologians conceived man as an immortal being endowed by the Creator with freedom of choice, and responsible in the hereafter for his errors. The deadly sins, according to the code of monastic morality, were: pride, avarice, anger, gluttony, unchastity, envy, vainglory, gloominess, and languid indifference! Each of these evidently indicates a supposed natural form of motivation. Virtues included: faith (or voluntary belief in God and his commandments), love of God and man, purity (indicating an aversion to the sexual), alienation from the world and the flesh, scorn of wealth, and humility (especially "before God"). These virtues all involve an abnegation of egoistic or erotic tendencies.

St. Augustine [8] maintained that man has freedom of the will, in spite of the fact that all men are born sinful, and foredoomed to punishment because of the misdeeds of Adam. Through love of God, and His Grace, any man may be redeemed. The essential Christian virtues are said to be faith, hope, and love. Early Christian thought probably received its first clear expression in the writings of St. Thomas Aquinas,[9] whose teachings smack strongly of Aristotle. According to him, all action is directed toward some end, which may be the acquisition of riches, honor, power, or pleasure, but which only God can satisfy. He classifies the passions into the concupiscible and the irascible. The former are excited by the mere perception of an object, and include love, hate, desire, aversion, joy, and sorrow. The latter are aroused by an obstacle, and are exemplified by hope, despair, fear, boldness, and anger. All of these together constitute the irrational part of man. The virtues are prudence, for the rational part; temperance, for the concupiscible part; and fortitude, for the irascible part. To these is added justice, as a criterion of the action of the will.

20. *Descartes and Mechanistic Theories*

The beginning of the modern period of philosophical thought is characterized by the appearance of materialistic, or physical explanations of human, as well as of animal behavior. It was hardly possible for the ancients to formulate doctrines of this sort at all clearly, because of the slight development of mechanical science in their time. The French philosopher, Descartes,[10] whose views laid the foundations of modern thinking, advocated a completely mechanical explanation of animal behavior, and a modified theory of this type for the activities of men. It is in the teachings of Descartes that we first find clearly described the physiological mechanism, now called the "reflex arc," which is the basis of all modern attempts to account for behavior in a purely physiological manner. In accordance with this idea, all bodily movements are due to impulses which pass to the muscles from the brain (or central nervous system) along the so-called motor nerves, these impulses ordinarily being derived from prior excitations which originate in a sense-organ, and arrive at the brain via a sensory nerve. Descartes taught that mechanisms of this sort were entirely sufficient to account for the behavior of animals, without the introduction of any mental or spiritual agencies, but he did not dare to eliminate the soul from his explanation of human action. So he assumed that in man the soul is capable of interfering with the transfer of the impulses through the brain. Acting in the so-called pineal gland, the soul supposedly could modify, block or initiate impulses which pass to the muscles.

Descartes regarded the soul as a unitary, or simple being, and the multiplicity of passions which influence our behavior was assigned to the action of the body upon the pineal gland and, thus, upon the soul. The six primary passions were said to be: wonder, love, hate, desire, joy and sadness. Other passions are compounds of these elements. Descartes exemplifies in very clear form the doctrine which is now known as interactionism, according to which psychical and physical things are radically different in nature but can, nevertheless, be related as cause to effect.

21. *Hobbes and Spinoza*

The British philosopher, Hobbes,[11] was a much more thorough-going materialist, at least by profession, but his teachings regarding motivation seem to be couched mainly in psychological terms. He denied freedom of the will, and tried to base a doctrine of human behavior upon the natural instincts of self-preservation and self-assertion. All mental states are divided into sensations, imagination, memory, and desire. Imagination initiates activity by picturing an end which is to be attained, and desire develops as the action proceeds. The opposite of desire is found in aversion, which is sensed as pain, whereas, the satisfaction of desire is felt as pleasure. In general, pleasure accompanies the facilitation of vital motions, while pain goes with their hindrance. Happiness consists in "the constant movement of desire toward fulfillment."

Although the doctrines of Spinoza[12] are stated in a form which is radically different from that employed by Hobbes, they amount to much the same thing in the end, desire being defined as the conscious expression of the impulse to self-preservation, which results in pleasure when successful and in pain when unsuccessful. We love whatever causes us pleasure, and hate what causes us pain. Moreover, we love what is favorable to what we love, and hate whatever hinders it. Sympathy comes from imagining another being as having a certain feeling, which causes us to experience it also. One of Spinoza's most important contributions consisted in showing how complex emotional tendencies can be developed through experience by a combination or interaction of simpler ones.

22. *British Intuitionists*

British thinkers subsequent to Hobbes, can be divided into intuitionists and utilitarians, in accordance with the nature of their psychological and ethical views. In general, the intuitionists tended to deal in ideas which are difficult to reduce to scientific terms and hence are not of great significance for our present purposes. However, certain valuable contributions to the doctrine of motivation were made by members of this school. Cumberland,[13] for example, although admitting the egoistic nature of primitive human motives in general, argued for the existence of an inherent sociability in man's nature. Shaftesbury also combated the "exclusive egoism" of Hobbes, and affirmed that the good man has a disinterested concern in the welfare of others, based upon his natural social impulses. According to Shaftesbury,[14] the springs of motivation fall into three classes: the natural affections, the self affections and the unnatural affections. The natural affections include love, complacency, good-will, and sympathy with our kind. The self affections comprise love of life, resentment of injury, bodily appetite, desire for the means of welfare and pleasure, emulation or love of praise, and indolence or love of ease and rest. Among the unnatural affections are to be counted all malevolent impulses such as cruelty due to superstition, barbarous customs, and exaggerated self affections. The natural or social affections operate on a hedonistic basis as a consequence of (1) their inherent pleasurableness (2) the sympathetic enjoyment of the happiness of others, and (3) the receipt of praise and thanks. Self affections frequently lead to pain, while social affections are requisite to happiness, even in the case of the voluptuary. Shaftesbury tries to prove that the best balance of affections for society is also the best for the individual. A somewhat similar view was advocated by Hutcheson,[15] who believed in a moral sense as one of the determinants of will.

Butler[16] taught that although man has a general desire for pleasure or happiness, such pleasure is only attained in the pursuit of definite objects. For example, the object of hunger is eating food and not the pleasure of eating. The primary impulses are thus not entirely egoistic, since following them is often prejudicial to selfish welfare, even when the impulses in question are not social. Pleasure results, however, when any impulse is followed, whether it be egoistic or social. Human nature consists of a system in which some motives are regulative of others; in other words, it is a kind of hierarchy of motives in which conscience and "reasonable self-love" are dominant. Butler paid special attention to the emotions of compassion and resentment, which he regarded as being directed toward the relief or production of misery in others.

23. *The Utilitarians*

The utilitarians were concerned with a demonstration that moral and economic control should be based upon the criterion of happiness. They sought to prove this by showing that the pursuit of happiness is the actual law of all human behavior or choice. David Hume, the Scottish philosopher, may perhaps be regarded as the founder of the utilitarian school, although the latter is, of course, closely related to the teachings of Hobbes and indeed of the Epicureans and the Greek atomists. The intuitionists, like Socrates and his followers, emphasized the importance of reason in the control of behavior but, according to Hume,[17] reason is no motive whatsoever for action. Reason is the slave of passion, and feeling and passion are "secondary impressions" arising directly, or indirectly, from pleasure and pain, which are the real motives of all voluntary action, "the chief springs or actuating principles of the mind." Nevertheless, Hume denied that "self-love," in the ordinary sense of the term, is the basis of all human behavior, and he regarded sympathy as an elemental trait which is responsible for social and moral behavior.

Jeremy Bentham[18] formulated the hedonistic doctrine of motivation in its most radical form when he said: "Nature has placed man under the governance of two sovereign masters, pain and pleasure. It is for them alone to point out what we ought to do as well as to determine what we shall do." As a basis for computing economic utility, he proposed a hedonic calculus, according to which the value of pleasure for the individual depends upon: (1) intensity, (2) duration, (3) certainty, (4) propinquity, (5) fecundity, (tendency to be followed by other hedonic consequences), and (6) purity (freedom from accompanying pain, in the case of pleasure). The value for the community depends furthermore upon (7) the extent, i. e., the number of persons sharing in it. Socially useful behavior can only be brought about by arranging social conditions so that men must thus behave in order to succeed in their individual quests for pleasure.

John Stuart Mill,[19] in his further development of the doctrine of utilitarianism, disagreed with Bentham's teaching that pleasures can be evaluated only quantitatively; and he distinguished between higher and lower pleasures. He said that choice between these is due to a "sense of dignity." Moreover, he believed that the sanctions of conduct for the welfare of others are not egoistical, but are based upon a rational appreciation of the fact that each man is an integral part of society, and that other men's claims for happiness are as important as one's own. Each man has a "feeling of unity with his fellow creatures."

A further development of the hedonistic theory, this time from a biological rather than from an economic point of view, appears in the writings of Herbert Spencer.[20] He makes the fundamental assumption that "sentient existence can evolve only on condition that pleasure-giving acts are life-sustaining acts," because sentient beings always strive to exercise functions which give pleasure and avoid those which yield pain. It follows that in the organism which actually results from evolution, pleasure and pain will be positively correlated with biologically beneficial and injurious processes, respectively. Spencer points out that although egoistic motives must develop, evolutionally, prior to altruistic ones, the latter may appear as a natural consequence of the struggle of the family or tribe for existence. However, altruistic acts are energized by the fact that they give pleasure to the individual who performs them.

Other hedonistic economists or psychologists include

Leslie Stephen,[21] who accepted happiness as the ultimate aim of reasonable conduct, but rejected the Benthamic calculus; Alexander Bain,[22] and James Mackaye.[23] The latter, who is a modern writer, has carried the idea of a mathematical calculation of pleasure values to its logical conclusion. He formulates a unit of pleasure-pain which he calls the "pathedon," and offers graphical representations of the course of affective experience in time, from which the sum of happiness can be estimated in "pathedon-seconds."

24. *Other English and French Thinkers*

Another English thinker of a different school, but who contributed some general principles which are of importance to the theory of motivation, was Hartley.[24] He adhered to the doctrine of association of ideas which characterized the British school of empiricists, but was interested in the physiological foundations of this principle. He regarded the processes of the nervous system as being vibratory in character and thought that the counterpart of association in the brain was the union of several vibrations to form a single one. He suggested that the mechanism by which particular sensory nerve processes arouse definite motor nerve currents, and thus bodily behavior, was similar to that of physical *resonance*. He pointed out that the "force or liveliness" of one idea can be passed over to another through association, and that emotional tendencies develop, through experience, in accordance with such a principle. Through association a motivating force can be transferred from one idea to another.

In France, Condillac[25] and Helvétius[26] developed a psychology on the basis of pure sensation, according to which all action and attention is determined by pleasure and pain. They taught that there are no specific hereditary tendencies of emotion or instinct, apart from a general susceptibility to pleasure and pain. Specific wants are determined by education and environment, in combination with this fundamental hedonic sensitiveness. Rousseau,[27] like

Erasmus Darwin [28] in England, endeavored to explain human behavior in society on the basis of a general innate "instinct of self-preservation." In the social environment, according to Rousseau, *armour de soi* becomes corrupted into *armour propre.*

25. *The Sub- or Unconscious Mind*

Probably the most important contribution which was made by *German* philosophy to the theory of motives lies in the idea of the subconscious or unconscious mind. Leibnitz [29] suggested this notion quite definitely in his Monadology, in which he regarded mind as a system dependent upon the interaction of psychical units differing from one another in clearness. Impulses may operate subconsciously or semi-unconsciously before they appear clearly in consciousness. Innate tendencies, such as those of self-preservation and sympathy, come to the surface only when experience gives them a chance. Perception and judgment can occur unconsciously.

The teachings of Schopenhauer [30] make an even more definite contribution to the conception of unconscious mental processes. Schopenhauer considered the universe as a whole to be a creation and expression of a striving mental force which he called *Will.* In its primary phase the Will is unconscious and unguided, but through its activity it forms itself into definite ideas, perceptions and emotions. Pleasure, pain, hope, fear, love, hate, are all expressions of the primitive striving. In all emotional activity, we are driven from below by motives, the significance of which we do not appreciate. According to Schopenhauer, pain is the only positive feeling, pleasure being only a momentary release from the painfulness of desire.

The German psychologist, Herbart,[31] made the notion of the subconscious even more definite. Mental processes, according to Herbart, are due to the quantitative interaction of distinct psychical units which he called concepts. Feeling arises when one concept interferes with or cramps another, and desire appears when a concept overcomes this interference, suppressing the opposing concept and enhancing those which are consistent with its own tendencies. Those concepts which have succumbed to this process of suppression are below the "threshold of consciousness" and, hence, lie in a *sub*conscious realm. However, in this state they are not without influence upon the conscious system. In fact, everything in consciousness is derived from and motivated by the subconscious forces. The views of Herbart are particularly significant in that they definitely introduced the idea of mental *inhibition or repulsion* as a complement to the already familiar principle of mental attraction or association which was the basis of British empiricistic psychology. This notion of suppression or the thrusting of an idea into the subconscious, as a result of conflict, plays an important part in modern "psychoanalytical" theories.

The idea of the unconscious forces of mind was given even greater emphasis by von Hartmann,[32] whose entire philosophy was founded on this notion. According to von Hartmann, feelings and motives are due to unconscious events and hence are not consciously understood. Even conscious intentions can be executed only through the instrumentation of unconscious forces. Consciousness and reason never initiate anything, but only observe and criticize, or else act as intermediate factors. Instinctive action is the expression of the fundamental unconscious forces.

26. *Nineteenth Century Tendencies*

Philosophical speculations concerning human nature shade into those which are of a more scientific character. The nineteenth century witnessed the development of many scientific ideas which have a bearing upon the theory of motivation. The doctrine of evolution as presented by Lamarck and Darwin necessitated that all tendencies to action, whether in men or animals, should be assigned definite survival values and that their genesis should be carefully considered. Interest in the mechanism and principles of heredity encouraged careful distinctions between inherited and acquired tendencies. Some schools of evolution maintained that acquired habits of action could be transmitted to offspring, whereas others rigorously denied this possibility. The concept of an instinct as an inherited action tendency having a definite biological function was greatly clarified by the new evolutionary thought.

Of even greater importance for our present purposes was the development of a direct physiological attack upon the problem of animal and human behavior. Descartes had paved the way for such a scheme in his doctrine of the reflex arc and his teachings regarding animal automatism. Subsequent thinkers, such as LaMettrie,[33] courageously applied his ideas even to human behavior, maintaining that there is no need for the introduction of mental forces to account for the manner in which organisms react to their environment. There is still a problem of motivation here, but it is formulated and solved in physical or physiological terms. The necessary foundation for such thoughts consisted in a better understanding of the mechanisms of muscle and nerve than was possible for Descartes. Such a foundation was laid by the researches of Johannes Müller, Helmholtz, Du Bois Reymond and other German physiologists. The experimental study of reflexes in animals and human beings has been carried on by a multitude of observers, culminating in the integrative work of Verworn[34] and of Sherrington.[35]

Another line of scientific development during the nineteenth century, which has not been without influence on the theory of motivation, is that of experimental or laboratory psychology. Ostensibly, this discipline covers the entire domain of mental phenomena and consequently should be expected to make the most positive of all contributions to our present subject. However, the problem of motivation is of course among the most complicated ones which the psychologist has to consider, so that it was not to have been expected that the early phases of experimental psychology would throw a great deal of light upon its solution. As a matter of fact, the problems of sensation and perception with which laboratory psychology began, have seemed to lead to very little which is of significance in relation to the common affairs of human life; so the layman has found the scientific psychological discussions of the later nineteenth century to be singularly barren of interest.

Nevertheless, the actual truth probably is that there is a great deal of information in the extant data of experimental psychology which is indispensable to a complete understanding of motivational processes. On the other hand, it has remained for the more speculative among modern psychologists to develop views dealing directly with motives. In the next chapter we shall outline some of the more significant of recent psychological doctrines in this domain.

Chapter III

Modern Theories Concerning Human Motivation

Modern psychological doctrines which bear primarily upon the problem of motivation can be divided into five or six rather definite groups. Probably the most intriguing class of theories is that which has received the general title, *psychoanalysis,* represented principally by Sigmund Freud. A close second in interest, and not without affiliation to the psychoanalytical views, lies in the psychological discussion of instincts, in which field William McDougall appears to be the outstanding figure. A third class of facts and theories is associated with the experimental study of animal behavior or response, without detailed analysis of the neuromuscular mechanisms which are involved. This begins with the German school of "animal physiologists," who affected to despise all purely psychological interpretations of animal activity, and is applied to human behavior in the work of the American school of "behaviorists" led by John Watson. The notion of the "conditioned reflex," introduced by the Russian physiologist, Pawlow, may be regarded as belonging to this line of thought. A further development which is of even greater ultimate significance, but which as yet has made no very definite contributions to an understanding of complex motivational processes, lies in the detailed analysis of neuromuscular action, as exemplified by the investigations of Charles Sherrington. In addition to above mentioned classes of doctrine, we may refer to the views which have been advocated in modern text-books of psychology from the standpoint of introspection, regarding the laws governing association, attention, feeling and volition.

27. *The Beginnings of Psychoanalysis: Janet*

The roots of the psychoanalytical doctrine are to be found in the notion of the unconscious or subconscious mind as developed by Leibnitz, Schopenhauer, von Hartmann, and Herbart. They also include Herbart's notion of mental conflict and suppression, as well as associated principles common to the majority of psychological thinkers. Furthermore, we can trace a resemblance between the psychoanalytical idea of a splitting of the mind into conflicting portions, and the Christian idea of a dualism of good and evil in the fundamental nature of man. However, the new facts which entered into Freud's own theory were drawn from a different source, namely, that of mental disorder, and principally from the phenomena of hysteria.

Now, the notion of a splitting of personality in hysteria was already clearly conceived in the writings of the famous French psychiatrist, Janet,[36] whose work under Charcot at the Salpêtrière marked an epoch in the study of certain mental diseases. Janet showed that in all cases of hysteria which came to his attention the disorders of consciousness or behavior could be referred to mental causes which were nevertheless beyond the knowledge of the patient in his normal state. The hysterical phenomena appeared to be controlled by a "fixed idea" which existed in the subconscious mind and was due to some previous experience of an extremely shocking or painful character. This experience had produced a so-called mental "trauma" or injury, which frequently split the personality into two or more definite sections, which subsequently were in conflict with one another. In the hypnotic state it was usually possible for the patient to recall the unpleasant experience and to report concerning the normally unconscious ideas. Janet found it to be a characteristic of many hysterical symptoms that they appeared to be regulated in a purposeful manner, although the purpose in question could not be found in the normal consciousness of the patient. In cases of hysterical anaesthesia there is meaningful response but no sensation or perception. Also, in somnambulisms, the movements which occur are as if consciously regulated.

The ideas of Janet were generalized in a helpful manner by Gurney and Myers [27] in their doctrine of the subliminal self. These writers were interested primarily in so-called supernormal phenomena in the domain now known as that of "psychical research," and had to deal in this connection with the mediumistic trance, a state which is usually associated with some degree of hysteria. They believed that the unconscious self can be in closer contact with the alleged world of spirits than can the ordinary conscious mind, and thus they were led to stress the importance of this subliminal section of the personality as a source of ideas and action.

28. *Freud's Views*

Sigmund Freud, a Viennese psychiatrist, carried these ideas even further and gave them systematic and general form. He advocated the idea of the subconscious or unconscious mind as an organized and motivated system in all human beings, whether or not hysterical. Although Freud's interests were primarily in mental disease, he developed a general dynamic psychology, which has proven to be of the utmost interest in the attempt to understand human impulses. It is well known that Freud's own writings deal not only with the special phenomena of hysteria and other mental disorders, but with such everyday matters as dreams, laughter, and slips of the tongue.

Freud [28] conceives the mind as being made up of two clearly separate departments comprising the conscious and the unconscious, respectively. Ideas, or mental contents, which are objectional to the forces which rule the conscious realm are very likely to be *repressed,* which means that they are thrust into the unconscious and debarred from returning to the upper domain. Such repression may be referable to a voluntary process and be a normal part of individual development in the social situation or, on the other hand, it may be due to special accidents of an unpleasant nature.

Such repressed ideas or "complexes," as Freud calls them, continue to operate in the unconscious field and to influence consciousness and behavior in a purposeful manner. Probably the most sensational feature of Freud's teaching, however, is his emphasis upon sexual motives. For all practical purposes, he regards the sex instinct as the basis of all psychical energy and striving. He calls this energy the *libido*. Naturally, in the ordinary social environment, the erotic tendency is subject to severe repression, and this has grave results in the case of unstable or sensitive individuals. The repressed agency constantly endeavors to reinstate itself and does so in surreptitious or camouflaged form, resulting in abnormalities of consciousness or behavior.

Although Freud, at least in his earlier writings, explicitly regards the sex tendency as the basis of all mental energy, an examination of his cases readily shows that other motivational agencies are implicitly concerned in the processes which he describes. The repressing agent, which Freud calls "the censor," standing on the threshold between the conscious and the unconscious, is evidently opposed in character to the sexual tendencies which it attempts to hold in the unconscious. In the majority of instances the repressing force is conceived to be that of the Ego, and the conflicts which are responsible for the Freudian phenomena are referred to the antagonism between this motive and that of sex. Freud recognizes the activity of the ego motive further in his doctrine of *Shadenfreude* or rivalry, of which he makes a great deal in his explanation of wit and humor, but his tendency is always to reduce seemingly non-sexual tendencies to some form or by-product of the libido.

Until very recently, Freud's theory of mental dynamics was essentially hedonistic. The forcefulness of the sex tendencies was attributed to their extreme pleasure-producing power, whereas repression was referred to the unpleasantness of the repressed mental content. The essential conflict therefore seemed to be between pleasure and unpleasure. In his very recent writings,[39] Freud has rejected the pleasure principle as a fundamental rule and regards the instinctive tendencies as energetic in themselves apart from their affective accompaniments. Nevertheless, the Freudian system as it stands is essentially hedonistic in its teachings. Freud treats pleasantness and unpleasantness as if they were mental entities similar to "ideas" in the traditional British psychology, which can be united with one another according to the principle of association. Such an associable pleasantness or unpleasantness, he calls an "affect." The combination of an affect with an idea, or other mental unit is designated as a "complex." The term, complex, may evidently be used narrowly for pathological and repressed groupings of this sort, or more broadly for all combinations of otherwise neutral units with affects.

Compared with an ideal scientific discussion, Freud's theory is quite vague, but in comparison with previous theories of motivation it is a marvel of lucidity. Freud pays very little attention to possible physiological accompaniments or foundations of his doctrine, using a language which is wholly psychological. The strength of his discussion lies in the multitude of his examples and in the great detail with which he analyzes their significance in terms of his basic principles. In some cases this analysis seems very far-fetched, but in others is very convincing.

29. *Freudian Mechanisms*

As examples of concrete applications of the Freudian doctrine, we may mention the following forms of explanation. Consider, first, dreams.[40] These are said to be experiences developed in the sleeping state—when the repressing forces are relatively inactive—in the interests of the repressed complexes. Either openly, or in symbolic form, according to the degree of censorship which remains, they satisfy the repressed desires. The "manifest dream content" may be taken from the experiences of the previous day, but the "latent dream thought" reveals some content of the restless subconscious. Similarly, errors of action, such as slips of the tongue, of the pen, mislaying things, and so on, are not to be regarded as accidental or purposeless. On the contrary, they are shown to express, and to be in the interests of, hidden motives. Wit and humor,[41] as the stimuli to laughter, also play upon the repressed sensibilities. A "joke" is a camouflaged appeal to repressed interests which, if not disguised, would be offensive to the normal consciousness. Lapses of memory[42]—or the persistent inability to recall names or words—are also referable to the action of repressed complexes which tend to absorb and obscure ideas that are closely affiliated with them.

The phenomena of hysteria are diverse expressions of the unconscious forces, which endeavor to express themselves in opposition to the censorship, and in so doing disrupt the normal course of the mental life. Sometimes hallucinations appear which tend to realize the appetitions of the repressed motives, and in other cases the behavior of the patient is modified in the direction of suppressed interests, contrary to his conscious intention. Consciousness is frequently distorted in the effort to establish an adequate *defense* against the activity of repressed systems. Another Freudian concept which is of great interest is that of *sublimation,* according to which the energies of sex, or possibly other reprehensible tendencies, find an outlet which is in the interests of social or intellectual progress. The transformation of their expression is then so complete that it is difficult to identify them. Freud refers the energy of creative activity largely to such sources.

The psychoanalytic method as a therapeutic procedure endeavors to ascertain the structure of the unconscious system by analyzing symptoms of the sort above indicated. Janet relied primarily upon the hypnotic state as revelation of the split-off components of personality. Freud, however, prefers to study dreams, associational tendencies and the like. In general, it is supposed that if the repressed complexes can be brought into the clear light of consciousness and their nature and causation clearly presented to the intellect, the repression will be relieved. This process of exhuming the buried wishes and ideas is called *catharsis*.

Freud's conception of sexuality goes much further than to regard this tendency as a mere general force. He believes that the erotic impulses of infants or children under six years of age are far more intense and complicated than is ordinarily supposed, and, indeed, than those of the ordinary adult. They involve, as natural affections, desires which, if retained in adult life, constitute perversions. Prominently among these tendencies is that of incest, which later furnishes the foundation for the Oedipus complex in men and of the Elektra complex in women. The basis of many religious ideas, of folk lore, and much that is essential in modern culture, is to be found in these infantile impulses, which are largely repressed, in the interests of society and the continuation of the species, in the adult.

30. *Other Psychoanalysts*

C. G. Jung,[43] who with E. Bleuler was one of the first to follow in the footsteps of Freud, finally came to differ with his master regarding the generality of the sexual motive. The unconscious, as conceived by Jung, is the container not only of repressed complexes but also of a system of inborn tendencies somewhat resembling instincts, which he calls *archetypes*. These instinctive factors are divisible into those which are sexual and those which are nutritive in significance, but the energy of both of them is still known as libido. The archetypes are said to result from a Lamarckian inheritance of acquired cultural ideas, and to differ from one race to another. They find expression in mythology and folk lore as well as in the products of individual thought or imagination. Jung is also responsible for the distinction between extraverted and introverted types of personality.

Another early disciple of Freud who has deviated from his master's teachings is Alfred Adler,[44] whose most famous contribution to psychoanalytical theory is his notion of the "inferiority complex." Adler's views apply primarily to abnormal processes such as those found in neuroses, and do not lend themselves readily to expansion into a general psychology. He rejects the assertion that psychical processes derive all of their energy from sex, but substitutes for sex an equally one-sided agency, in the view that the neuroses, at any rate, result from attempts to compensate mentally for some bodily or organic deficiency. The individual represses his recognition of the defect and thus generates an inferiority complex. His behavior is then governed by a tendency to justify this repression and to convince himself and others of his real *superiority*. Thus it would appear that Adler regards the "will to power," or egoistic supremacy as the primary motivating force.

Another follower of Freud who has not adhered strictly to the latter's views is W. Stekel,[45] who also takes issue with the idea of the exclusive primacy of the sexual motive. According to Stekel, the neuroses depend not only upon sex but upon ambition, religious feeling, and the instinct of self-preservation. Other exponents of the psychoanalytic views include O. Pfister,[46] E. Jones,[47] and A. A. Brill,[48] all of whom are essentially Freudian in their teachings. W. A. White's [49] discussion of "mental mechanisms" also contributes to the clarification of certain psychoanalytical doctrines. We should also mention E. B. Holt's [50] book on "The Freudian Wish," which suggests some interesting ideas concerning the physiological basis of the Freudian phenomena, and of which more later.

31. *Morton Prince*

Still another contemporary psychiatrist who has made important contributions to the general type of theory represented by the psychoanalysts is Morton Prince.[51] For him, the unconscious is a vast reservoir of impressions and tendencies and the forces of the unconscious are by no means limited to those of the libido. Prince accepts the view of McDougall that the energies of mind depend upon instincts and agrees with him that there is a plurality of independent instinctive forces. Prince furthermore divides the subconscious into two sections, the co-conscious and the unconscious, the former lying functionally nearer to the introspective consciousness than the latter. The unconscious receives and retains sensory impressions in great detail, even when they do not attract conscious attention; and such impressions play a part in controlling the exact forms of later consciousness or behavior. In general, the unconscious acts as a motivated and thinking system, similar to but more fundamental than the conscious mind. In cases of *dissociation* there are two or more purposive systems which struggle with one another.

32. *Earlier Views Regarding Instincts*

It is characteristic of the psychoanalysts that they pay very little attention to the biological foundations or affiliations of their conceptions, dealing in terms which are of a vaguely defined psychological nature. They also neglect to consider the principles of academic and general experimental psychology. Hence it is to be expected that a synthesis of the psychoanalytical principles with data from other fields will result in a doctrine having greatly enhanced clearness and explanatory power. The first step in this direction is taken by such writers as McDougall in establishing a relationship between biologically defined *instincts* and psychologically conceived motivational forces.

It seems impossible on the basis of contemporary discussions to formulate an exact definition of the term, instinct, which will apply satisfactorily to all of the uses to which the word is put. In a general way, it is agreed that an instinct is an inherited tendency to action of a specific kind, usually set off by a limited range of stimuli, and having definite survival or biological value—in the struggle for existence. As a rule, an instinct is conceived as a purely physiological mechanism, although the term may be used loosely as if it stood for a psychical force having a teleological or purposive form. The most mechanistic conception of an instinct regards it as being comprised of a group of reflexes or processes of a fixed type, energizing the muscles via the out-going nerves. Perhaps the least mechanical conception is that of McDougall, in his more recent views, according to which an instinct is a purposive force, the motor expressions of which are very plastic or variable. However, the prevailing interpretation makes an instinct wholly biological or physiological and not to be confused with its possible accompaniments on the mental side.

One of the earliest systematic discussions of instincts is that of Chadbourne,[52] who interprets them more or less psychologically. He speaks of a set of "appetites" which are common to men and animals. Furthermore, in man, there are instincts leading to progress, such as the "desire for society, the desire for knowledge, property, power and esteem, the impulse to confide in others, and the disposition to work for the welfare of posterity." There are also instincts leading to benevolence and religion. Santlus[53] divided instincts into those of "being, function and life."

The psychology of William James was characterized by an original emphasis upon motor expression, which led him to take an interest in instincts. He maintained that, contrary to the usual opinion, the human being is not essentially devoid of the instinctive equipment which seems to be possessed by animals, but that instead man has such a wealth of instinctive impulses that they tend to obscure one another. James[54] bases a long list of so-called instincts upon earlier catalogues offered by Preyer[55] and by Schneider.[56] This list embraces many motor expressions which would ordinarily be regarded as reflex, because of their relative simplicity. These simpler responses include: sucking, biting, chewing, licking, grimacing, spitting, clasping, reaching, pointing, ingesting, crying, smiling, protruding lips, turning head aside, holding head erect, sitting up, standing, locomotion, climbing, vocalization, etc. The more complex forms of instinctive behavior comprise: imitation, emulation or rivalry, pugnacity, sympathy, hunting, fear, acquisition, constructiveness, play, curiosity, sociability, (and shyness), secretiveness, cleanliness, modesty and shame, love, jealousy and parental love.

E. B. Titchener[57] indicates a quantitative scale of instincts, at one end of which lie movements which are closely allied to reflexes—coughing, smiling and the like—which are definite responses to particular stimuli; and at the other end of which are to be found broad, general tendencies involving detailed perceptions, and exemplified by: empathy, social tendency, the inclination toward pleasure and away from pain. Between these extremes lie the instincts proper, embracing fear, love, jealousy, rivalry, curiosity, pugnacity, repulsion, self-abasement and self-assertion, and so on. Nearly every psychological text has its own peculiar list of instincts.

The views of Lloyd Morgan[58] regarding instincts are of considerable interest. He classifies instincts in accordance with three levels: first, simple motor tendencies; second, mid-level instincts; and third, high-level instincts. The latter include self-preservation and race preservation, while the second class embraces instincts such as fear. He says: "Instincts are complex reflexes constituting adaptive behavior of the organism, the nature of which is determined by the inherited structure and the physiological dispositions of the subcortical nervous centers. It is these complexly coördinated reflexes which determine instinctive behavior as I define it; and if the organism were possessed only of subcortical centers there would be the end of the matter." However, as he goes on to say, the subcortical centers influence the cortex and thus give rise to "instinctive experience." The cortex, in turn, reacts upon the instinct mechanisms and modifies instinctive behavior in accordance with laws similar to those elucidated by Sherrington. The subcortical agencies may be combined or separated under the control of the cortex, Pawlow's principle of the conditioned reflex being the primary means of combination.

33. *McDougall on Instincts*

From the standpoint of motivational theory, the most interesting doctrine with regard to instincts is that elaborated by McDougall, who advocates a detailed correlation between a list of instincts and one of emotions. Instincts are regarded as semi-physiological entities, whereas emotions consist primarily of the psychological effects which follow from the arousal of specific instinctive processes.

In his *Introduction to Social Psychology,*[59] McDougall says: "The human mind has certain innate or inherited tendencies which are the essential springs or motive powers of all thought and action . . . and are the bases from which the character and will of individuals and of nations are gradually developed under the guidance of intellectual faculties." There are two main classes of these: first, specific tendencies or instincts, and second, general or non-specific tendencies arising from the general nature of mind and its course of development.

Instincts, or instinctive forces, as thus defined, are not rigidly fixed in nature, in spite of their hereditary basis, but are capable of being modified by "experience," in four different ways. In the first place, there may be an addition to or complication of the stimuli which naturally arouse them. Secondly, the motor expressions may be modified. Thirdly, the instincts themselves may become associated or combined as a consequence of their simultaneous excitation. Finally, it is possible for all of the instincts to become organized about certain central objects or ideas. McDougall steadfastly maintains that all of the energy of mind or behavior is derived fundamentally from some instinctive source and that habits in themselves cannot constitute adequate motives. This idea is definitely combated by R. Woodworth, in his theory of "drives," who claims that all response tendencies carry with them a certain amount of self-sufficient energy.

McDougall's attitude toward the "pleasure theory" of action is somewhat ambiguous. In general, he is opposed to this view and regards it as something to be shunned religiously. The primary springs of action are "hormic" forces which are represented by the instinct-emotions. However, he asserts that pleasure and pain "serve to modify instinctive processes, pleasure tending to sustain and prolong any mode of action, pain to cut it short; under their prompting guidance are effected those modifications and adaptations of the instinctive bodily movements which we have considered." This was in his *Introduction,* and in his *Outline of Psychology*[60] McDougall still adheres to this view, since he says that "pleasure sustains, prolongs and confirms the modes of striving which bring pleasure, that is, successful modes; pain or displeasure on the other hand checks us, discourages, and turns us aside from the line of effort which we are pursuing now, or have pursued unsuccessfully in the past. To this fundamental feature of its nature the mind owes its directive power, its power to guide and improve our modes of striving toward our goals." Apparently, what McDougall means to say is that the desire for pleasure or the aversion to pain is not what initiates action, although habits of action are really determined—at least in part—by affective concomitants of the behavior which is primarily energized by instinctive forces.

McDougall's catalogue of these instinctive forces is quite detailed and correspondingly valuable. The "principal instincts," which are correlated with the "primary emotions" in man are as follows: (1) the instinct of flight and the emotion of fear, (2) the instinct of repulsion and the emotion of disgust, (3) the instinct of curiosity and the emotion of wonder, (4) the instinct of pugnacity and the emotion of anger, (5) the instinct of self-abasement, and the emotion of subjection (negative self-feeling), (6) the instinct of self-assertion and the emotion of elation (positive self-feeling), (7) the parental instinct and the tender emotion, and finally (8) all instinctive agencies or emotional states which are compounded out of the above. The "minor instincts," which have less well-defined emotional accompaniments, include: (1) the instinct of reproduction, (2) the gregarious instinct, which involves sympathetic feeling, (3) the instinct of acquisition (leading when successful to the pride of possession), and (4) the instinct of construction. Jealousy and coyness are said not to be based upon special instincts. Lastly, we have to consider *general innate tendencies,* or susceptibilities, which embrace: (1) sympathy or the sympathetic induction of emotions or instinctive actions, (2) suggestion or suggestibility, (3) the tendency to imitate (which, however, is not an instinct), (4) the tendency towards play, and (5) temperament, which varies with individuals, but which is an hereditary factor in personality. In his *Outline of Psychology* McDougall gives a revised list of instincts as follows: curiosity, food-seeking, mating, repulsion, escape, appeal (calling for help), gregarious, primitive passive sympathy, combat, parental or protective acquisitive, constructive, self-assertive, or submissive; and finally—as special simple instincts—sensorily induced reflexes, such as sneezing, coughing, etc. Play is now regarded as aimless activity.

The practical application of McDougall's principles rests primarily upon his conceptions of *sentiments and complexes.* From the subjective standpoint, a sentiment is "a system of emotional tendencies organized about the various objects, or classes of objects, which excite them." [61] It is a consequence of the association of objects, perceptions or ideas with instinct-emotions. As examples of sentiments, we may consider the love or hatred of definite persons or things; such mental processes as reproach, anxiety, resentment, shame, joy and sorrow may be regarded as expressions of particular sentiments. "A single primary or instinctive disposition may give rise to a number of systems, or secondary dispositions which remain connected with it, and actuated by it; and any one such system of dispositions concerned with a particular object or class of objects, together with its coöperating and actuating primary disposition (or dispositions, for two or more may take part in the formation of a system), constitutes a sentiment or complex." [62] The development of personality depends upon the creation and organization of particular sentiments in the individual. On the physiological side, the attachment of instinct-emotions to new objects follows the principle of the "conditioned reflex" (Pawlow's law), depending merely upon an initial conjunction of the two in the same experience.

34. *Other Instinct Theories*

Another recent systematic discussion of the part played by instincts in human nature is that of W. E. Hocking.[63] His general concept of an instinct and its relation to emotion is very similar to that of McDougall, but his system of instinctive forces is more complex. They are divided, first, into the positive—which seek objects or stimuli—and the negative—which are aversive in intent. On the positive side, we have a long list of "units of behavior," which can be aroused in various combinations and by different stimuli; curiosity and sociability, the latter embracing domination, sex-love, parental love, and attachment to parents. On the negative side, we find fear, aversion to food, aversion to novelty, and anti-sociability. The latter includes pugnacity. The negative instincts may be divided also into the aggressive and the defensive, pugnacity lying on the former and fear on the latter side.

Since the promulgation of McDougall's views, a large number of psychological writers have delivered themselves regarding instincts; and the status of these forces in human life has been much debated. Some authors, for example, Z. Y. Kuo,[64] completely deny the existence of instincts in the human being, and endeavor to explain all human behavior on the basis of innate "units of reaction" which have no inherited relation to specific stimuli. Other authorities, such as Knight Dunlap,[65] use substitutes for instincts. Dunlap prefers to speak of "fundamental desires," his list being as follows: (1) desire of aliment, (2) desire for excretion, (3) desire of rest, (4) desire of activity, (5) desire of shelter, (6) desire of conformity, (7) desire of preëminence, (8) desire for progeny, and (9) desire of sex gratification. He asserts that these desires are essentially of a sensory nature, or pertain to the afferent part of the nervous system, whereas instincts are ordinarily defined with special reference to the motor, or efferent portion. We shall consider some of the details of this debate concerning instincts in subsequent chapters dealing with this or closely related topics.

35. *Allport, Kempf and Others*

F. H. Allport,[66] in his discussion of social psychology, replaces instincts by "prepotent reflexes," the general nature of which we shall consider in the next chapter. The specific prepotent reflexes which Allport utilizes for the human case are: (1) starting and withdrawing, (2) rejecting, (3) struggling, (4) hunger reactions, (5) sensitive zone reactions (tickling, etc.) and (6) sex reactions. These responses are naturally aroused by definite stimuli, but are subject to modification by experience, firstly by an extension of the range and complexity of the stimulus which can arouse them, and secondly, by a refinement and specialization of the reactions. The pleasant emotions are referred primarily to the action of the cranial and sacral divisions of the autonomic nervous system, and the unpleasant ones to the processes of the sympathetic divisions. Woodworth[67] makes use of the division of reflexes into *preparatory* and *consummatory*, as an essential feature of his discussion of "drives." We shall consider all of these views in detail in later chapters, from a critical standpoint.

Another comparatively original motivational theory which nevertheless has affiliations with the instinct doctrine of motives is that of E. Kempf.[68] This writer seizes upon the distinction between two parts of the central nervous system, namely, the cerebrospinal and the autonomic sections, as a basis for his reasoning. He regards the autonomic system as the source of psychical energy or unrest, whereas the cerebrospinal, or projicient, system is merely an elaborate instrument for carrying out the desires of the autonomic portion. Thus the autonomic plays the same part as does the system of instincts in McDougall's theory. The affections or emotions are referred entirely to the autonomic section. This view is rendered particularly plausible by the experimentally demonstrable fact that the autonomic system is concerned in the production or regulation of physiological processes which are fundamentally involved in certain instinctive actions or emotions. In fact, the "dispositions of the autonomic" form a list which is closely similar to that of fundamental emotional susceptibilities. The fear reaction, for example, is well known to involve the sympathetic section of the autonomic, whereas the sex reactions are at least partially controlled by the sacral division. Kempf discusses in detail how the various dispositions of the autonomic can be conditioned or associatively aroused by sensory processes set up in the projicient system, and, in general, his working principles closely resemble those of the psychoanalysts or the McDougallian school.

Another class of doctrines, which shade into those of Kempf, attempt to develop explanations of emotion and personality on the basis of our knowledge of the "internal secretions." One of the most radical views of this sort is that of L. Berman,[69] who writes concerning "the glands regulating personality," and presents a sort of "endocrine psychology." Another theorist in this class is G. W. Crile.[70] In general, it appears that every physiological or psychological feature which is in any way associated with emotion has, in one place or another, been regarded as the sole basis of emotional life. In connection with the operations of the autonomic system and the glands of internal secretion, we should not neglect to mention the remarkable empirical discoveries of W. B. Cannon,[71] who, however, has not been guilty of any very speculative elaboration of his results, leaving this for more daring thinkers. We shall review these facts and fancies more in detail later in their appropriate connections.

Chapter IV

Doctrines Concerning Motivation in Animals

Scientific theories concerning motivation have been influenced to a very high degree by the study of animal behavior, and by facts drawn from the experimental analysis of neuromuscular response in lower organisms. Probably the greatest contribution has been made in this field by so-called animal or "comparative" *psychology,* which has as its governing interest an insight into the conscious "minds" of animals. Nevertheless, the actual data of this science are in themselves physiological, since it is always necessary to arrive at notions concerning the "animal mind" by a process of inference. The uncertainty of such inferential reasoning has led numerous students of animal behavior to reject the psychological interest, and to regard the problem as exclusively physiological—or in modern terms, behavioristic—in character. It does not make a great deal of difference, practically, which standpoint is adopted, although the physiological one seems to be the safest.

36. *Early Views Regarding Animal Behavior*

Prehistoric man, and later ancients, were ardent believers in the mentality of animals, attributing to them motives essentially human in nature. The conception of instincts as hereditary, or God-given, forms of behavior played an important part in the very earliest scientific thinking regarding the activities of animals. Even before the rise of the modern evolutionary movement, there was a conflict between those who believed animals to be endowed with an elaborate instinctive equipment and others who sought to develop explanations of animal action on the basis of "experience" or simpler impulses. In the eighteenth century, we find Condillac [72] and Erasmus Darwin [73] endeavoring to show how the behavior of animals can arise in the individual as a consequence of learning; whereas Reimarus [74] appealed to a very large number of specific inborn tendencies. In the later nineteenth century, we see Fabre [75]—as a consequence of his detailed studies of the life of insects—viewing instinct as a kind of super-biological force peculiar to animals and enabling them to accomplish marvelous things, on a basis entirely different from that of human reason.

According to the Lamarckian view of evolution,[76] instincts may result from conscious desire on the part of an animal, which leads to efforts directed towards a certain end, these efforts modifying the organic structure, and the modifications being transmitted to progeny to influence their behavior in turn. For example, a giraffe stretches its neck in the endeavor to reach the leaves or fruit on trees, and endows its offspring not only with a long neck, but the impulse to use it effectively. Although Charles Darwin [77] advocated quite a different mechanism of evolution, he did not neglect the problem of instinctive behavior and the anatomical equipment therefor. He applied his doctrine of accidental variation and natural selection to instincts as well as to other organic structures and functions; and said that if instincts are subject to variation, even the most complex instinctive responses can be evolved as a consequence of the struggle for existence and the survival of the fittest.

The really scientific study of animal behavior did not begin until Darwin's teaching had given its impetus to the general idea of evolution and impressed itself upon psychological thought, so that psychologists began to look for the genetic sources of human consciousness in the mental life of lower species. This interest prompted the collection of observations which tended to show the essential similarity of animal and human mentality. The demonstration of intelligence in animals occupied the attention of such students as Lubbock, Romanes, and Darwin, himself. The "anthropomorphic" tendency reigned supreme, and the result was contributory more to the glory of evolutionary doctrine than to the discovery of any new principles.

37. *Loeb and the Radical Mechanists*

During the last decade of the nineteenth century, Jacques Loeb[78] and Lloyd Morgan directed their efforts against the tendency to interpret animal behavior wholly by analogy with that of human beings. Loeb's *tropistic* theory reverted definitely to the Cartesian automatism, and attempted to explain the movements of the simpler animals on a basis very similar to that of the resolution of physical forces. According to the doctrine of tropism, animals are provided with response systems which are balanced about certain axes of symmetry in their organisms. A condition of equilibrium with regard to the exciting stimulus is produced when the animal orients itself so that the portions of the response mechanisms on either side of the axis are equally stimulated. Thus, an animal will swim towards the light because, firstly, the light rays excite movements of forward propulsion in the swimming apparatus, and secondly, because these movements become of equal intensity on the two sides of the body only when the illumination of both sides is equal. This mechanism necessitates that under light stimulation, the animal shall not only move toward the source of light, but in doing so shall turn until it faces the luminous point. Simultaneously operative tropisms, based upon different kinds of stimuli, may also resolve themselves in this way, to yield resultants which have as complex a mechanistic foundation as may be required. Loeb developed his views even to the point of explaining advanced instinctive behavior in accordance with tropistic—or at least, mechanistic—conceptions.

Loeb's mechanistic views gave rise in Germany to a school of *physiologists*, represented by A. Bethe, Th. Beer and J. von Uexküll,[79] who proposed to eliminate all psychological conceptions from the study of animal action. They announced a plan of analyzing animal behavior entirely in terms of physiological elements. This attitude was more radical than that of Loeb, who admitted the existence of psychical activity in cases where "associative memory" appeared to play a part. However, these animal physiologists made no important contributions of a specific nature to the understanding of animal activity. They may be regarded as the forerunners of the modern doctrine of *behaviorism,* as applied to human as well as to animal response by John B. Watson.[80]

The radical mechanists were opposed by Lloyd Morgan and his co-workers, who continued to study animals as psychological beings. However, Morgan's "canon"[81]—which exerted such an important influence upon subsequent animal investigations—warned students against undue intensity in their psychologizing. It admonishes that "in no case may we interpret an action as the outcome of the exercise of a higher psychical faculty if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale." This principle is not without application to theories of motivation.

38. *Random Movement*

The systematic study of animal behavior in the laboratory, under controlled experimental conditions, did not begin until the last years of the nineteenth century. E. L. Thorndike,[82] Watson[83] and R. M. Yerkes[84] may be regarded as the pioneers in this method of attack. The studies which most concern our present interests are those of random movement, reflexes, instincts, and learning. Random movement would appear to be a more primitive form of reaction than a reflex, since there is no attachment of the movement to a particular stimulus. Nevertheless, it furnishes a basis for the most advanced form of response, that which is established by "experience." Reflexes and instincts blend into each other in such a manner that the distinction between them seems to be quantitative rather than qualitative, depending upon the degree of complexity of the given innate form of response. The questions arising out of the experimental study of animal learning are undoubtedly the ones which are of the greatest significance for the theory of motivation.

Watson [85] finds that, either in the young animal or human infant, "(1) the number of random and unadapted acts is far greater than is the number of organized adaptive reflexes and instinctive acts; (2) that under the influence of natural environmental demands or training many of these separate random acts can be organized into acts which are usually, but not necessarily, serviceable to the animal; and (3), finally, that many of them lie unorganized throughout the life history of the individual. . . . The random and spontaneous reflexes, unscrutinized by the physiologist,—the ceaseless movements of hands and arms, the facial muscles, and the turning and twisting of the trunk muscles and head as a whole, and later, climbing movements, running, jumping, etc.,—are of vital importance to the behaviorist, in view of the fact that every habit which is later put on by the animal must inevitably be analyzable into just such units. What is new in habit is the organization. The elements, in general, are as old, or as new as the race."

39. *Sherrington on Reflexes*

The experimental study of reflexes has employed a more refined technique and has yielded more definite scientific results than any other department of animal experimentation. The methods have usually been those of laboratory physiology rather than psychology. The animal psychologists—even when behavioristic—have not as a rule concerned themselves with questions about the internal mechanisms of the responses which they studied. Their primary concern has been to ascertain the external relations between stimuli and effector (or muscular) reactions. Physiologists, such as Sherrington, however, have been primarily interested in uncovering what might be regarded as *explanations* of the relations in question. They have regarded response, not merely as a logical concatenation of stimulus and movement, but as a conduction process within the neuromuscular system. The two methods of attack are thus complementary to each other in a very useful manner. The physiological studies have naturally been restricted mainly to the simpler response mechanisms—such as the reflexes and their combinations—whereas the behavioristic ones have frequently dealt with much more complex reactions. However, such intricate responses can often be regarded as combinations of the more elemental forms.

In a later chapter, we shall consider the consequences of the Sherringtonian type of analysis in considerable detail. At present we need only outline the general nature and significance of this line of study, together with certain salient ideas which are definitely involved in the general theory of animal behavior. The physiological analysis of response should provide the theory of motivation with a clear and detailed account of a physical apparatus which operates mechanistically, without any vagueness or uncertainty. In the end, this method of attack upon the problem will not permit us to deal in terms of pseudo-psychical entities such as instincts, hormic forces, drives, and other hazy conceptions. In the words of von Uexküll, the iron chain of physical events which constitute response is linked together in the middle, and nowhere is any place left for the "psyche" of the animal,—or man. We may thus see how and why organisms behave as they do, by having recourse only to principles which, on the surface, appear to be *non-motivational* in character. These views, also, will not be predominantly hypothetical—as are those, say, of the psychoanalytical school—but will be based upon a very imposing array of convincing data.

The fundamental unit of the physiological analysis is the *neurone* or single nerve cell. Considered as a biological cell, the neurone has been differentiated so as to specialize in the functions of excitation and conduction. It consists of a cell-body, or "perikaryon"—containing the usual cell nucleus—and a number of tentacles or fibrous extrusions. These latter are divided into two classes, the dendrites and the axon. There is only one axon, but it ordinarily constitutes the main conducting filament of the cell. Although the cell and the fibres are of microscopically small diameter, the axon sometimes has a length of several feet. In normal response conduction, the axon carries impulses only outwardly from the cell body, whereas the dendrites serve to pick up disturbances and to transmit them to the perikaryon and axon.

40. *Pawlow and the Conditioned Reflex*

Within the organism, neurones combine to form complex conducting arcs or circuits, which connect sense-organs with muscles or glands, and these arcs are so organized that stimulation of a sense-organ usually results in characteristic, coördinated movements, or postures, on the part of the muscles and the other portions of the body to which they are attached. The simpler of these responses are known as reflexes. Study of the conditions which underlie reflex action shows that the basis of the process is primarily hereditary, being substantially the same in all members of the same animal species. The individual life-history of an animal is, however, capable of modifying the exact character of its reflex responses. One of the most interesting forms of such modification is that known as *conditioning,* or the establishment of a *conditioned reflex,* which was first demonstrated clearly by the experiments of the Russian physiologist, Pawlow.[86]

Pawlow's work was done upon the salivary reflex of the dog, which consists in the secretion of saliva, as a consequence of the gustatory (or taste) stimulus which is provided by food in the mouth. If, however, simultaneously with feeding the animal, we introduce some other stimulus, such as the sound of a bell, we find that eventually this secondary stimulus becomes able to arouse salivation in the absence of food. The salivation is then said to be *conditioned* upon the secondary stimulus, which has no hereditary association with the glandular process. The arousing of salivation by the secondary stimulus is said to comprise a *conditioned reflex.* The same principle can be demonstrated in the case of reflexes other than those of salivation.

The principle of the conditioned reflex, or Pawlow's law—as it is sometimes called—has been hailed by some psychologists as an epoch-making discovery, and whole systems of psychological thought have been founded upon it. Other psychologists have, however, appreciated the fact that, after all, the principle is fundamentally similar to the classical doctrine of the association of ideas, and has about the same consequences for behavior as has this older doctrine. The true significance of Pawlow's experiments lies in his demonstration that the association principle is physiological as well as psychological in its applicability. This, also, is certainly not a new idea; but prior to the work of Pawlow it may have lacked empirical justification. Pawlow's own experiments show quite clearly that the location of the conditioning mechanism is in the higher brain centers —primarily the cerebral cortex—which is also conceived to be the "organ" of psychological association.

Some of the conditions which govern the operation of Pawlow's principle are of importance to the theory of motivation. Krestownikow [87] found that it was impossible to establish a conditioned reflex if the secondary stimulus was applied *after* the primary one, even if the latter was still operative. However, there is great latitude as regards separation in time, when the secondary stimulus precedes the primary stimulus. It is not even necessary that the two stimuli should overlap in time. In fact, an interval as long as thirty minutes can be interposed between the two stimuli, and yet a conditioned reaction may still be established. In this case, if we follow the ideas and terminology of G. V. Anrep,[88] we are dealing with a "trace reflex," since the reaction is conditioned not by a direct sensory process, but by its record, or "trace" in the nervous system. The delay which exists between the secondary stimulus and reaction in the process of establishing the conditioned response, is apt to appear also in the response which is aroused at a later time by the secondary stimulus alone. Thus, salivation may not occur until a definite time after the bell has been sounded. It seems doubtful, however, whether this delay will always be present in the conditioned reaction.

The number of repetitions required to establish a conditioned reflex is sometimes quite large, and the conditioning usually shows a tendency to decay as a consequence of disuse. Conditioned reflexes ordinarily exhibit a marked degree of specificity. Thus, according to S. Morgulis,[89] a dog may be taught to respond with salivation to the sound of a tuning fork, corresponding to 1,000 vibrations per second, and will fail to react to a fork having a vibration rate of 1,012 per second. However, the specificity is reduced in the case of a "trace reflex," which does not differentiate definitely between stimuli of the same class as applied to different positions on a given sensory area, such as the skin of the back. Hence, the trace reflex is said to show extensive "irradiation." When a certain stimulus, such as a particular musical pitch, is associated consistently with feeding of the animal, while a different stimulus—say, another musical pitch—is uniformly accompanied by lack of feeding, the result is not merely a failure of this second stimulus to arouse salivation, but it tends actually to *inhibit* this latter reaction. This is shown by the fact that if the two stimuli are applied together, the salivary reaction is reduced or perhaps wholly suppressed.

41. *Kinds of Reflexes*

Another interesting property of reflexes which was first clearly demonstrated and defined by Sherrington, is that of their relative potency, or "prepotency."[90] When two or more reflex mechanisms come into conflict with each other, it is found that one of them dominates over the other or others. Certain reflexes or classes of reflexes are almost always victorious in such a conflict. These "prepotent" reflexes are ordinarily aroused by stimuli which have a psychical accompaniment of pleasure or unpleasure. For example, the reflexes which follow from pain stimulation dominate over those which would be set off by mere pressure or contact. On the pleasure side, sexual reflexes prove to be prepotent over other reflex tendencies. Reactions of the so-called "consummatory" type are usually strongly affective (pleasant or unpleasant) and hence prepotent. As examples of "consummatory" reactions, we may consider *swallowing,* which terminates a series of so-called preparatory or precurrent reactions serving to bring the food to the proper position in the alimentary canal so that swallowing can begin; also, the ejaculation of seminal fluid, which terminates a long series of sex reactions. These Sherringtonian concepts have been employed by a number of comparative and social psychologists in an endeavor to explain certain phenomena of animal behavior. We shall consider some of these explanations below.

42. *The Theory of Animal Instincts*

The problem as to the existence and nature of animal *instincts* has received much attention at the hands of modern experimentalists, and a vast multitude of specific observations have been made upon the hereditary response endowments of many different species. The problem is complicated by the absence of any sharp line of demarcation between instincts and reflexes. The majority of actual reflexes are very intricate in their neuromuscular mechanisms. Many so-called instincts can readily be interpreted as being reflex in character, and the notion that an instinct is a system of reflexes, organized with respect to some particular function, is especially plausible. Thus, the "sex instinct" may not consist of anything more complex than the sum of all of the reflexes which are involved in reproduction. In many cases, the responses do not assume the form which we call "instinctive" until "experience" has had an opportunity to modify or to organize the elements which are provided by heredity.

Nevertheless, the modern scientific study of animal behavior leaves little doubt that the majority of the lower animals can exhibit highly complex forms of adaptive response which are not attributable to learning or experience. Thus, the little bird inside of the egg "knows how" to chip the shell along a circumferential line and escape. Some of these "instincts" appear only after the animal has reached a certain advanced age—a phenomenon known as "maturation" [91]—(for example, the sexual responses of the monkey at the age of one year) but may operate perfectly the first time, without practice. In other cases, the "instinctive" responses are very crude in the beginning (the pecking of some young birds for food) and are greatly improved by exercise. Some so-called instincts, such as the songs of bird species, may rest in part upon imitation, but, also, in part upon an innate tendency. Instinctive response may wane as a consequence of disuse. It may also be modified in very radical ways through the action of environmental forces, or other processes peculiar to a particular individual life-history. It is obviously impossible in the present book to enumerate the instincts of all animal species, but in a later chapter we shall consider those of the human being in considerable detail, and also such instinctive responses of animals as seem to throw any light upon problems of human behavior.

Instincts resemble reflexes especially in that they are subject to the process of "conditioning." The experiments of Watson,[92] M. C. Jones [93] and others upon babies have indicated that the complex systems of response which accompany emotional disturbances can readily be attached to a new stimulus. In fact, a single conjunction is usually sufficient in the case of such responses to establish a very powerful dependency of the reactions upon the secondary or artificial stimulus. There appears to be rather conclusive evidence that the association between such reactions as those of fear, rage, hunger, etc., with particular objects or situations (special configurations of visual, auditory, or tactual stimuli) is never determined by heredity, but depends upon "experience." Thus, Watson showed that infants are not naturally aroused to fear by seeing animals, no matter how ferocious the animals may be. However, any loud sound will set off fear reactions, and if a dog barks in their immediate vicinity they subsequently exhibit fear when the dog appears to them, visually, without barking. This process of conditioning emotional or instinctive responses is evidently closely similar to, if not identical with, that of forming sentiments or "complexes" as described by Freud or McDougall. We shall consider it in great detail in a subsequent chapter.

43. *Thorndike's Theory of Learning in Animals*

The problem of animal learning, or of the formation of new responses, was first attacked experimentally by Thorndike,[94] who observed the reactions of monkeys as well as of lower species, such as dogs and chickens. One of Thorndike's most interesting methods was that of the "problem box," or "puzzle box." The animal may be placed in a cage from which it can escape only by making the movements which are required in order to operate a latch; or food may be put in the box and the animal must learn the method of getting at it from the outside. It is found that the animal makes a long series of trial movements, nearly all of which are ineffective, until finally it chances to hit upon the right one. In a subsequent test, the number of unsuccessful attempts is likely to be greatly reduced, the successful one appearing more quickly than it did during the first experience with the box. Eventually, the animal will make the proper movement immediately it is faced with the problem.

Thorndike at first explained the increase in the tendency for the successful movement to occur, on the principle that the *pleasure* of its consequences "stamped it in." Similarly, in cases where punishment is employed to discourage a particular movement, the resulting unpleasantness was regarded by Thorndike as acting to "stamp out" the movement in question. Thorndike's own formulation [95] of this principle is as follows: "Of several responses made to the same situation, those which are accompanied or closely followed by satisfaction to the animal will, other things being equal, be more firmly connected with the situation, so that, when it recurs, they will be more likely to recur; those which are accompanied or closely followed by discomfort to the animal will, other things being equal, have their connections with that situation weakened, so that, when it recurs, they will be less likely to occur. The greater the satisfaction or discomfort, the greater the strengthening or weakening of the bond." He calls this the "law of effect." Two other laws are involved in learning,[96] namely, those of use and disuse. The law of use states that "any response to a situation will, other things being equal, be more strongly connected with the situation in proportion to the number of times it has been connected with that situation, and to the average vigor and duration of the connections." According to the law of disuse, a response tends to lose its connections, with the lapse of time.

Although Thorndike's hedonistic principle has not been generally accepted by psychologists, the effects which it endeavors to formulate have been very generally utilized as a basis for investigations of the sensory and other faculties of animals. If it is desired to know whether or not an animal can discriminate between two different colors, an attempt is made to train him to *react differently* to them. He is placed in a situation where he is impelled to react to one or the other of the colors, and in one case he is given an electrical shock (or otherwise "punished"), whereas on choosing the other alternative he is rewarded with food. It is presumed that if the animal is capable of making the discrimination between the two kinds of stimuli, he will form a habit of reacting to them in such a manner as to secure the reward and to avoid the punishment. This seems to imply in general terms that pleasant consequences will reinforce a given form of response, whereas unpleasant ones will break it down or inhibit it. Thus, after the habit has been established, we can say that its "historical basis" lies in the pleasantness or unpleasantness of the experiences with which it has been associated.

44. *Watson's Theory of Learning*

The hedonistic interpretation of these effects has not, however, been very popular among animal psychologists. In the first place, there is the difficulty that pleasantness and unpleasantness can exist only in the consciousness of the animal, and cannot be invoked if we profess to adhere to a strictly physiological viewpoint.[97] Secondly, even if we admit consciousness, we have to explain how its hedonic processes can "stamp" response tendencies "in" or "out": an aspect of the familiar difficulty of psychophysical interaction. Furthermore, it is perhaps an unjustifiable generalization from the concrete and special experimental situations which have been studied, that all pleasant and unpleasant experiences act in this fashion. Possibly the effects are peculiar to the stimuli of food or pain, or their nervous accompaniments.

Quite a different explanation of the learning process was advocated by Watson,[98] who attempted to reduce the whole affair to the statistics of the laws of use or exercise. He starts with the proposition that impressions upon the nervous system are proportional to the *recency* and *frequency* of the forms of response which are concerned. Watson points out that in a series of trials by an animal, the successful movement will be the most "recent," because it terminates the series. It should, also, occur more frequently, on the average, than any other movement, because it will be present in every series, since the animal continues to struggle until it escapes from the box or obtains the food. Watson argues that, on the average, the successful response will occur twice as frequently as any other one, for this statistical reason.

This explanation has been rejected by Thorndike and other psychologists, because a closer study of the situation —both theoretically and experimentally—shows that Watson's analysis is fallacious. His conclusions rest upon the tacit assumption that the trial movements are like cards drawn from a hat; if they are taken once, they cannot be taken again. But the actual situation as shown by the experimental observations of J. Peterson[99] and of Kuo,[100] resembles that of drawing cards which are immediately replaced in the hat. Hence the successful response may sometimes occur less frequently than unsuccessful ones; but observation shows that this does not prevent it from being established as the predominant habit. The influence of recency still remains, but this is generally considered to be very slight, except where the experiment is repeated upon the animal within a very short time. The essential factor appears to lie in the force which terminates the series of trials, or which, perhaps, is operating throughout the series, and is released at the end. A physiological definition of "success" as a release from continued effort or struggle seems to become the most important element in an understanding of the learning process in such experiments.

45. *Learning and Consummatory Reactions*

An attempt along this line has been made by Margaret Washburn.[101] The final act in the problem-box experiment consists in a consummatory and prepotent reflex, the swallowing of the food, and this becomes associated, in accordance with the principle of the conditioned reflex, with the "successful" act which makes ingestion possible. This association transfers some of the "prepotency" of the reflex to the successful response and causes it to become relatively dominant over the other "unsuccessful" reactions. Consequently, when the animal is again faced with the problem, it shows an increased tendency to react in the manner which made the consummatory reflex possible and thus terminated the series of trials. In a similar manner, the association of a reaction with reflexes arising from pain stimulation is almost certain to interfere with the continuation of the reaction in question, since as a rule the reaction to the pain will be incompatible with that which brings about pain stimulation, or which permits it to continue. Under these circumstances, the prepotency of the pain reaction will cause it to eliminate or replace the opponent tendency.

It is of course recognized by Washburn that the most fundamental principle of learning among animals—as also in human beings—is that of the mere persistence of any type of response which has once been carried through. This depends, of course, upon the tendency of conduction along any path in the nervous system to break down resistances along the path in question. It appears that many animals, such as insects and birds, are able to remember, or to retain a record of the sensory stimuli or afferent nerve impulses which have accompanied a given initial reaction; and then to utilize this record as a guide to subsequent responses. Thus, bees find their way back to their hive after a single trip away. The use of the afferent pattern may, however, be considered to depend upon its association with a consummatory or prepotent reaction, which terminates the journey.

In the case of animals, which are given the problem of running a "maze," learning seems to consist in the establishment of a *chain* of responses that follow each other almost mechanically in a fixed order which is requisite to the attainment of the goal. The animal requires, in the first place, an *incentive* to enter and investigate the maze, this consisting ordinarily of hunger and the olfactorily recognized existence of food somewhere in the maze. The series of turns and progressions which are successful in leading the animal to the food may be regarded as a unified system which becomes associated with the final consummatory reflex, and is reinforced as a whole through such association, over and above any other alternative series of movements. We may also consider that the series will tend to abbreviate itself to correspond with the shortest possible path through the maze, because of the increased association of the longer paths with the hunger, or the absence of the stimulus to the consummatory reaction. In some cases the series of movements can be regarded as constituting an entirely efferent or motor system, whereas in other cases it undoubtedly involves "sensory memories," or the interplay of afferent and efferent mechanisms.

46. *Craig's Scheme*

Wallace Craig's [102] experiments upon the behavior of doves led him to a very interesting conception of the nature of so-called instinctive activity, which involves the idea of a consummatory response, and is not without bearing upon the theory of learning. An "appetite," according to Craig, is assignable to the absence of a particular needed stimulus and comprises a state of physiological unrest which disappears only when the stimulus is found and sets off a consummatory reaction. An "aversion," on the other hand, is aroused by the presence of a particular stimulus, and the accompanying state of unrest disappears only when the stimulus in question is removed by the appropriate consummatory reaction. These two processes may be combined in a single series which is characteristic of appetites and their satisfaction. Beginning with a certain physiological state, such as that of hunger, there is an arousal of restless movement, taking the form of efforts or search and having as a possible outcome the discovery of a stimulus which is appropriate to bring the physiological state to an end. Upon finding such a stimulus (say, food), the animal executes a consummatory reaction (say, the swallowing of the food) in response to it, which is followed by the removal of the disturbing physiological state and a consequent subsidence of the activity. If the stimulus now continues to act, it may itself become a disturbing force, resulting once more in restlessness and effort directed toward getting rid of it. When a movement is finally executed which eliminates the disturbing stimulus, the state of rest again ensues.

If we apply this doctrine to the problems of learning, as Washburn does, we may say that the removal of a state of unrest reinforces or "stamps in" the response which is concurrent with (and perhaps the cause of) this result. When this physiological state of unrest or an object of aversion is repeated, it tends to rearouse the movements which were successful in removing it on the previous occasion. In case a series of movements is required—as in running a maze—the influence will be exerted upon the entire series. Considerable difficulty has been experienced by some thinkers in understanding how the influence of the final "reward" can be sufficiently retroactive to establish the earlier members of a series of this sort; but, as Washburn points out, the physiological state of unrest or the object of aversion is present throughout the entire series and becomes associated with each member in succession. The resolution of the appetency or aversion must react through the medium of the original processes upon the entire series of responses, establishing the association between the successful movements and the appetency in the proper serial order.

47. *Köhler on "Insight"*

The observations of W. Köhler [103] upon the behavior of certain of the higher apes when they are confronted by a problem, show that the initial reactions of these animals may frequently be well adapted to solve the problem. It is only necessary that they should be able to see, or visualize, the situation in its entirety. Köhler criticizes such experiments as those of Thorndike on the ground that they artificially blind the animal to the character of the situation which it faces and hence render impossible the exhibition of "intelligence," or *insight*. Where the facts are visually before the animal, the latter does not ordinarily act at random, but is guided by the combination of desire (for food) and the stimulus pattern so as to reach the goal usually at the first attempt. Köhler's animals behaved in these experiments as if they were "sizing up" the situations before them, finally and suddenly arriving at a satisfactory solution, and then proceeding to act intelligently. Subsequently, they would employ the same method of gaining the food when faced again by the same situation. In this process there is apparently only one "trial" and no errors, but the "success" of the single trial nevertheless appears to have a bearing upon the adoption of the corresponding form of response as a habit. Moreover, it seems quite likely that while the animal is apparently sizing up the situation, he is imaging various alternatives to himself and rejecting those which he perceives "will not work," so that a cerebral trial and error process may still be involved. This is certainly what happens in the majority of cases of initially intelligent trials by human beings.

It is evident that all of these theories, although very suggestive, are unfortunately lacking in detail and clearness. The exact mechanism of the learning process has not yet been made clear, the explanations which have been offered being rather too subtle to represent an actual process. They frequently suggest some of the Freudian analyses in this respect. One of the principal purposes of the present book is to develop a theory of learning which will be comprehensive, clear and straightforward in its application. Such a theory must, however, embody many features of the views which we have outlined in the present chapter.

Chapter V

The General Nature of Neuromuscular Response

We should now be in a position to begin a direct attack upon our problem: the development of a clear and comprehensive theory of motivation. In order that the theory shall be comprehensive it must take cognizance of most of the concepts and principles which have been considered in our review of previous discussions. In order, however, to be clear it must avoid or improve upon the methods of thinking which have been used in some of these earlier expositions. In the first place, we must shun what may be called the *fallacy of simplicity,* under the influence of which we may try to show that some single factor in human life is actually responsible for the entire system. Secondly, we must avoid both the confusion of physiological with psychological concepts, and the rejection of either of these as unimportant. Perrin and Klein,[104] in beginning their discussion of "the motivation of behavior" say: "The student will find it profitable at this point not to attempt to distinguish too closely between physiological and psychological phenomena." Without denying that this may be good advice to a beginner, it is the least profitable of all possible admonitions for the purposes which we now have in mind, namely, that of arriving at as complete an understanding as possible of the entire group of facts which relate to human or animal action.

We can approach the problem of motivation from either the psychological or the physiological side. Two distinct systems of facts have to be considered, each requiring methods which are appropriate to it alone; and finally the results of these two treatments must be coördinated into a psychophysical doctrine. Unfortunately, we are afflicted with approximately equivalent amounts of ignorance with respect to each side of the question. Certain conceptions and principles are very clearly established regarding the physiological mechanisms involved in behavior, but—sad to say—our information becomes almost *nil* when we consider the more complex nervous processes which must constitute the key to voluntary human reactions. It is just on this level of the motivational scheme that the introspective data of psychology, together with introspectively founded concepts and principles, supply the greatest amount of information. When it comes to the simpler processes, again, introspection becomes woefully weak. Thus in a certain sense, the physiological and psychological ideas are complementary to each other; but we should be very, very careful not to let this mislead us into supposing that we can combine them directly into a single system.

All things considered, it seems most advisable to make the first attack upon the problem of motivation from the physiological angle; but in discussing the general principles of the neuromuscular or response mechanism, we shall do well to indicate the relation in which consciousness, or the psychical system stands to the physiological one.

48. *The General Nature of Physical Reality*

In the first place, we must establish the notion of the organism—animal or human—as a purely *physical* mechanism, having a nature which renders it quite incapable of combining with any psychological entities or processes. Now, the average reader—even if he is a professional psychologist or physicist (unless he is both, and at the same time a philosopher)—may well fail to gather the full import of this statement; so that it becomes necessary to dilate to some extent upon the exact nature of physical being.[105]

When we use the word, physical, we shall refer to something which is made up exclusively of units which the modern theoretical physicist regards as forming the foundation stones of the universe, and which is governed only by the elementary laws which the physicist conceives as applying to such units or their combinations. The layman thinks of the physical world in terms of hard and soft, colors and shades, sounds and smells, etc., but the modern physicist knows that these concepts are really psychological or, at any rate, are only symbols for the things with which his own thought is concerned. His world is made up of electrical particles arranged into geometrical, dynamic patterns, in physical space and time. Of these ultimate particles, there seem to be only two different kinds, namely, the electron and the proton, which appear to exist in about equal numbers in the universe. By virtue of their forces of electrical attraction, electrons and protons combine with one another to form a vast variety of very complex structures, which are capable of being described exclusively in geometrical and electromagnetic terms. These structures can be arranged into a hierarchy which, in increasing order of complexity, may be sketched as follows.

The electrons and protons combine, firstly, to generate a series of atoms which range from very simple to quite complicated forms, and which correspond approximately with the table of chemical elements. Each neutral atom contains an equal number of protons and electrons, but there are, nevertheless, residual electrical forces which make it possible for atoms to adhere to one another and thus to produce still more complex structures, known as molecules. The molecules correspond with compound chemical substances, of which there is a much wider variety than there is of chemical elements. Molecules and atoms are both supposed to be so small as to be entirely invisible, even when using the most high-powered of microscopes. However, molecules can combine with one another by a process which does not differ essentially from the one by which they, themselves, are formed—to yield particles or structures which may be visible even to the naked eye. The smallest of these are known as "colloidal particles," whereas larger ones constitute *crystals.* A still further aggregation of molecular, colloidal, or crystalline units gives rise to the inorganic and organic bodies with which we are most familiar in everyday life.

The distinction between animate and inanimate bodies, which corresponds to that between the organic and the inorganic, appears to the unscientific mind to involve a fundamental difference of kind. This persuasion is apparently due primarily to the seemingly spontaneous activities which are exhibited by organisms, whereas inorganic objects usually move only under the influence of an external force. It is also supported by the knowledge that in the case of our own organisms, the activity is closely correlated with certain psychological phenomena which seem to be its causes. However, since these psychological phenomena lie outside of the domain of physical investigation they cannot be regarded as furnishing really pertinent evidence, and we are without proof that psychical factors do not also accompany the existence and *in*activity of inorganic bodies. Of course, the common sense conviction as to the uniqueness of living beings finds representation in certain quasi-scientific doctrines, which are called "vitalistic"; but by far the great majority of scientific thinkers resolutely reject these notions. They believe that the distinction between the organic and the inorganic is one of *structure* rather than of fundamental nature. The ultimate stuff and laws of the two classes of bodies are regarded as identical.

49. *Organisms as Physical Bodies*

In order to account for the difference which evidently exists between living and non-living bodies, the physically-thinking biologist has recourse to the demonstrable complexity of organic structure. This intricacy of constitution provides the basis for a corresponding complication of process. Hence, in general, if we wish to understand the activities of organisms, we must first determine their structures or anatomies. The activities should then be found to follow logically, just as do the motions of a machine, as a necessary consequence of the relations of parts. The "necessity" is that of fundamental physical laws, or their corollaries or combinations. This conception of the basis of organic activity is usually called "mechanistic."

We must be careful, however, not to give the adjective, "mechanistic," an unduly old-fashioned interpretation. When we compare organisms to machines, we do not mean that they have a rigid and metallic constitution. We do not imply that the principles of *mechanics,* alone, are sufficient to account for their behavior. Mechanics is only one subdivision of physical science, and at the present time it occupies a rather subordinate position. It is true that the principles of mechanics have many applications to organic activity, but in order to understand such activity we must also utilize the laws of chemistry, optics, electrostatics and dynamics and, in fact, of probably every known physical science. It is by no means beyond the pale of physical explanation that organisms should be fluid, plastic, impressible, spontaneous, and even seemingly quite unreliable in their behavior.

We know that the complexity of structure which is characteristic of organic beings begins even at the molecular level, as a consequence of the unusual variety and size of the molecules which can be formed by the element, carbon, in combination with hydrogen, oxygen and nitrogen. Living beings appear primarily to be expressions of this chemical versatility of the carbon atoms. Such compounds of carbon include many substances which are of the colloidal type, having very large molecules which are easily modified in exact form and properties under the influence of relatively slight external forces,—or even forces of their own constitution, acting slowly. *Protoplasm,* which is the classical concept of living substance, is an elaborate mixture of such colloidal materials. As a consequence of the process which we call evolution, certain forms of protoplasm have become established on this planet through their superior ability to survive the destructive action of external and of internal forces.

Their most potent means for resisting such destructive action consist in an ability constantly to reproduce themselves out of raw materials found in their environments. This reproductive capacity is readily explicable in physicochemical terms as a manifestation of a process known as *autocatalysis*.[106] The continued struggle of protoplasmic matter for existence, over a long period of time, has led to the establishment of a vast multitude of arrangements for accomplishing this result, these arrangements corresponding to different organic species. In general, the most successful scheme has been that of generating a *vehicle,* taking the form of a living organism, which may be more or less complex. In their more primitive exemplifications, organisms consist of single so-called biological cells; but the greatest success in the struggle against dissolution is evidently achieved through the formation of larger organisms which consist of an intricate structure of differentiated cell units. Such many-celled organisms can be arranged in order of their complexity, the most intricate of all being, of course, the human.

Now, if it is true that organisms are actually built up in accordance with the above sketch, exclusively of physical units, it should really be possible in the last analysis to account for all of their properties and activities by means of purely physical principles. Virtually all modern biologists believe firmly in this possibility; in fact, it is the primary tenet of their scientific faith. Nevertheless, they are not so foolish as to suppose that their knowledge of the details of organic structure, and of the physics of such structures; is adequate to permit any very complete explanation at the present time. We are still in the process of investigating these things. Consequently, in a great many cases, we have to make use of principles which we cannot trace back in full detail to doctrines of ultimate physics. Moreover, if we are trying to develop a tentative explanatory scheme, as in the present book, we are compelled to fill in many gaps by the method of scientific guesswork or hypothesis. Just because he recognizes these facts, the physical biologist is not liable to be over-awed by vitalistic attempts to demonstrate the impossibility of physical explanations of certain kinds of organic behavior.[107] It is not at all surprising that organisms exhibit very peculiar properties, since their structures are also very special; and physical explanations rest upon particularities of structure even more than they do upon the rigidity of ultimate scientific principles.

50. *Psychophysical Parallelism*

Now, if we adhere firmly to the above conception of organisms as physical systems, it is really impossible for us to include any mental or psychical terms whatsoever in their supposed operations. However, it would be equally absurd to deny the *existence* of these psychical factors, since their reality is far more evident than that of the physical terms. The physical ideas are the outcome of an elaborate and frequently hazardous process of reasoning, whereas the psychological phenomena are always with us, no matter what our opportunities or capabilities may be in the domain of scientific thought. Consequently, it appears that the physical and the psychological data must be organized into logically distinct scientific systems, and that the problem of their interrelations must be considered as a third question, separate from that of the internal relationships of the terms within the two respective accounts. This method of treating the facts is given the name, *psychophysical parallelism.*

The parallelistic view, first proposed by Leibnitz, has been the working scheme of the majority of scientific psychologists since his time. However, it has aroused severe intellectual pains in philosophic minds, thus stimulating many a violent reaction against it. It is fundamentally opposed to the natural desire for a monistic explanation, and to the demand for continuity between processes which go on in synchronism with each other, as do those of body and mind. Behaviorists and exclusive physiologists turn their thoughts away from the mental side of the parallelism, in an endeavor to avoid recognition of its obnoxious features. Idealists and exclusive introspectionists find unity in a shut-in mentalism. Interactionists, and blurry thinkers in general, scoff at the scheme as an academic creation, and mix physical and psychological notions at random. But if we envisage all of the facts in their empirically demonstrable relationships, and in the light of the most firmly established modern theories, we cannot escape the parallelistic method. Other views lead to confusion or neglect. Nevertheless, the mystery which is generated is far from being insoluble, without entailing either of these undesirable features. Concerning such a solution, we shall have more to say later.

51. *The General Mechanism of Response*

Suppose, now, that we attempt a general physical analysis of the mechanism or apparatus which modern physiology offers in at least partial explanation of human and higher animal behavior. This apparatus, which we may designate as the *response mechanism,* is essentially that of the nervous system, although it of course involves in its processes all portions of the body and particularly the muscles. Response is ordinarily said to be initiated by objects or stimuli in the environment of the organism. However, in many cases, particularly where we are dealing with human behavior, it is very difficult to identify the objects in question, unless perhaps we look for a clue in the accompanying introspective consciousness. The activities of living beings would not be so characteristically spontaneous if it were always evident that their causes lay in the environment.

Nevertheless, the most helpful approach to a study of these more difficult cases is by way of an understanding of the more typical kind of response, which begins with an object. This object must act upon a sense-organ by means of a force or energy, which is called the *stimulus,* if it is to call forth a reaction from the organism. Thus, in the case of visual response, the object emits or reflects *light* which enters the eye and stimulates the retina. The latter is an example of a *receptor* mechanism, in which the stimulus initiates an excitation of the nervous system. The receptor process, in turn, is followed by a transference of the excitation to a so-called *afferent* nerve fibre, along which the disturbance is propagated to a nerve center, such as those of the spinal cord or brain. The processes which transpire at the nerve center determine along what path the excitation will be conducted in an outgoing direction to reach the muscular system. In other words, the central process is of critical importance in determining the character of the reaction or behavior in any given instance. For this reason, it is sometimes called the *adjustor* process. Its mechanism always involves one or more *junction points* between individual nerve fibres, such points being known as *synapses.*

After leaving the central, synaptic, region the disturbance passes along an afferent or outgoing nerve, and is transferred, through a mechanism known as the *end-plate,* usually into a muscle. Muscles are the most typical examples of the class of *effectors,* which also include glands and electrical organs (in certain fishes). The arrival of the excitation at the effector is marked by the characteristic *reaction,* which controls the relation of the organism to its environment. This may be regarded as the last stage of the response activity, and be designated as *the effect.* When we study response in the superficial manner which characterizes behaviorism, or the everyday observations of the behavior of men or animals, we usually recognize only the first and the last links in this chain of events, and very frequently we miss the first link.

The mechanism of response, as above outlined, belongs to a class of processes known as *propagation* or *conduction.* A disturbance is set up a certain point in space at a certain instant, and this gives rise to a series of further disturbances at successively different points in space and instants in time. Other examples of processes of this sort are to be found in the propagation of radiant energy, or of sound, in space; or the conduction of fluids through pipes, or of electricity through wires. They are controlled by a number of fairly simple general principles. Firstly, the path of the conduction depends upon the structure of the conducting medium. Secondly, the nature of the process at any point in this path is a function of the nature of the conducting medium at the same point, as well as of the character of the activity at the immediately preceding point. The propagation of the disturbance is energized, or pushed

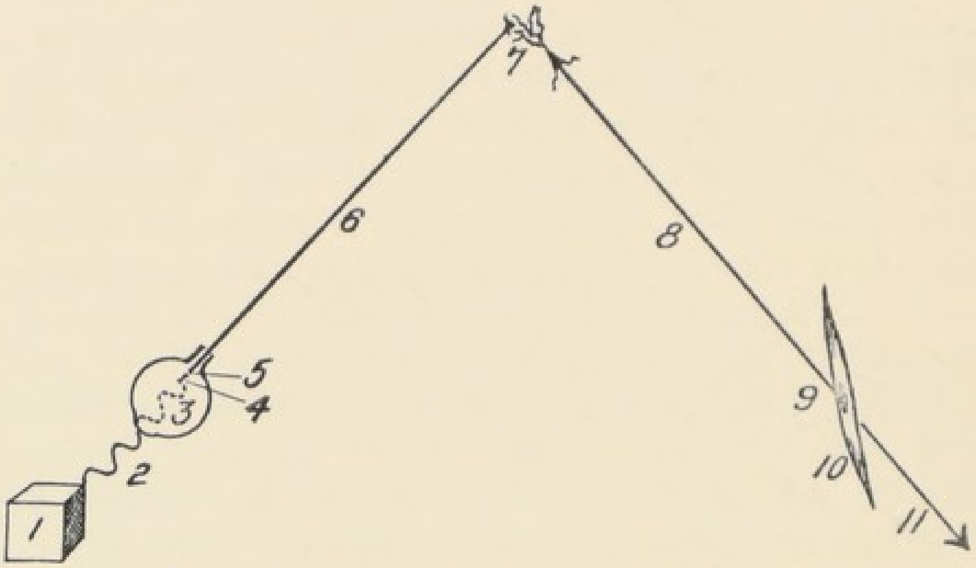

FIG. 1. SCHEMATIC DIAGRAM OF THE RESPONSE ARC.

The figure represents a simplified visual response process, consisting of eleven successive stages or phases, as follows: (1) the object, (2) the stimulus, (3) the sense-organ process, (4) the receptor process, (5) the afferent nerve excitation, (6) the afferent nerve conduction, (7) the central adjustor or synaptic process, (8) the efferent nerve conduction, (9) the end-plate process, (10) the effector or muscle reaction, and (11) the effect upon the organism or the environment.

by an agency which corresponds to *pressure or voltage,* but the process is impeded by another factor exemplified by viscosity or *resistance.* The conduction may be regarded as an outcome of the struggle, or balance between these two determining factors. In the case of electrical conduction this relationship is expressed mathematically in the formula known as *Ohm's law,* according to which the current strength is proportional to the voltage and inversely proportional to the resistance. At a later point in our discussion we shall consider in considerable detail the analogy between the laws of electrical and of nervous conduction.

52. *Parts of Response Related to Consciousness*

The sketch of the nature of response which we have just given is so greatly simplified with respect to the actual facts that it is hardly more than a symbolic representation of the latter. However, before proceeding to consider the ways in which concrete response mechanisms are complicated by the introduction of further details of structure, it may be well to indicate the general relation which obtains between the *psychical* terms and processes and the typical diagram of response. In the first place, we must recognize that the general psychophysical relation is one of mathematical interdetermination, as represented by functions or equations. This means simply that, given certain aspects of the response, the conscious processes follow—or, more strictly speaking, *occur simultaneously*. There is no structural linkage between the two things; they are merely logically or mathematically correlated, so that one can be *inferred* from the other. Neither one is logically prior to the other.

The next question is as to what particular aspects of the response are concerned in this relationship. Many different answers have been given to this question. Common sense is apt to refer experience primarily to the object of the response. Earlier psychologists tended to emphasize the stimulus and sensory activities, while some moderns have tried to associate the psychical processes essentially with the motor or efferent stages. However, all available empirical data support the view that the *direct correlation* of consciousness is limited to the central or adjustor stage; the relationship to other stages being due to the linkage between them and this central activity. This view of the correspondence between the psychical factors and those of response explains all of the facts of common observation, as well as those of the laboratory or clinic. The apparent dependency of our sensations and perceptions upon the objects before our organisms, or the forces which are acting upon our sense-organs, is referable to the fact that the central or brain process is determined by the train of conduction which is initiated by these agencies. The character of the central activity then determines that of consciousness. In a similar way, the seeming control which our conscious volition exercises over our muscular behavior is referable to the fact that the central mechanism governs the latter and is also a function of the psychical operations. The idea of the exclusive direct relationship of mind and brain has led some thinkers to speak of the brain as "the seat of consciousness," but it is evident that this can only be regarded as a figure of speech. There is no way in which we can conceive of consciousness as being located in the brain, or as being integrally associated with the central nerve processes.

We may now return to consider some of the complications of the response mechanism. The symbolic response structure which we have already outlined is not even sufficiently complex to correspond with the simplest "reflexes." All actual reflexes involve at least three nerve conductors in series, instead of two, the third one being interpolated between the afferent and the efferent conductors of our sketch. At the same time, the conduction is never limited to the pathway through a single chain of fibres, but occurs simultaneously in parallel along a very considerable number of such units. The existence of these parallel lines of conduction is responsible for some of the most striking features of response, particularly in human beings. On the afferent side, the exact distribution of the parallel excitations creates a *pattern* of conduction which is a controlling feature in the more complex forms of response. On the efferent side, the multiplicity of outwardly conducting paths presents *alternatives* from which the actual motor outlets must be chosen in accordance with the bias of the adjustor mechanism.

53. *Convergence and Divergence*

Now, there are certain general principles which apply to the simultaneous conduction of response impulses along adjacent paths. In the first place, there is a marked tendency for them to *converge* or to condense upon one another as they proceed. This convergence is due to the manner of concatenation of the nerve fibres and can occur *functionally* only at the synaptic points, where there is a transfer of the excitations from one set of conductors to another; but there is also a *geometrical* convergence of the efferent nerve fibres in their paths from all parts of the body to the central nervous system. Functional convergence involves the passage from a larger to a smaller number of conducting elements. This principle is exemplified in Sherrington's conception of the "final common path," which is ordinarily a motor nerve, in the case of simple reflexes. Such a common path can be energized from a considerable number of different sensory stations. However, in the more complex forms of response, the convergence point is to be looked for in the brain, rather than in the efferent nerves.

In some cases of response we are also concerned with a principle of *divergence,* since the higher nerve centers exercise a simultaneous control over a very large portion—if not the whole—of the bodily musculature in typical cases of voluntary response. Nerve currents, emanating from a relatively small section of the brain, spread out fan-like to all parts of the organism. In some cases, sensory control of this fan of motor impulses may be found in a very restricted "initial common path." Consider, for example, the act of striking at a biting mosquito in the dark. Very frequently, if not usually, in the case of response which is controlled through the higher nerve centers, we are concerned simultaneously with convergence and divergence. A large number of nerve impulses are *focused* at one time upon the center and regulate another complex outflow of excitations therefrom.[108] We may picture this process in terms of a double fan, resembling the passage of a cone of light rays through a focal point.

54. *Response Conduction Patterns*

The processes of convergence and of divergence are of particular interest in relation to the notion of *conduction pattern.* The idea of such patterns is of the utmost importance to an understanding of the more complex forms of response. It may be well to make this conception more vivid by means of a concrete example. Let us consider a case of visual response, which is naturally the easiest kind to "visualize." Now the notion of pattern can be applied to every stage of the response, beginning with the object and ending with the effect. In each stage it is a matter of the arrangement of parts in space; for the object, it is simply the spatial form of the latter with particular reference to the manner in which various portions of its surface are reflecting, or emitting, light in the direction of the observer's eyes. In the second, or stimulus stage, the pattern is comprised by the configuration of light rays which are passing from the object to the pupils of the eyes. This pattern is primarily an arrangement of directions of movement rather than of points on a surface. In passing through the eye the pattern is again changed as a consequence of the shifting of the directions of the rays, which is brought about by the refractive action of the ocular media. As a result of this an image or optical picture of the object is formed on the sensitive retina of the eye. This retinal image pattern is followed by the formation of a corresponding or registering pattern of visual receptor processes in the retinal rods and cones.

The response now passes into the fibres of the optic nerve, of which there are about a million. All of these are simultaneously excited in any act of vision, and the kind of behavior which results must obviously depend to a large degree upon the pattern of distribution of the excitations over the individual conducting components in these complex bundles of nerve fibres. At the moment when the nervous disturbance passes from the receptor cells to the conducting nerve fibres, the pattern has a close geometrical resemblance to the retinal image; but within the conducting layers of the retina itself there is almost immediately a radical condensation and change in geometrical form. This is referable to the fact that, except in the center of the retina, a considerable number of receptors connect in party line fashion with a single nerve conductor; and also to the convergence of the nerve fibres upon the point in the eye-ball where they emerge as a compact cable. Along the further course of the visual impulses from the eyes to the brain, there are other regions of transfer and of redistribution of the fibres, which cause still more radical changes in the exact geometrical arrangement of the individual nerve fibre excitations. When the impulses reach the cerebral cortex the pattern bears hardly any geometrical resemblance to the structure of the original object. Nevertheless, the exact configuration of the excitation in the cortex is determined in a fairly reliable manner by that of the object.

Starting at the cerebral cortex and proceeding in an efferent or outgoing direction, there will ordinarily be a complex outflow of nerve impulses along the so-called pyramidal system of neurones; and the exact pattern of this outflow may be controlled by that of the visual processes. However, the motor pattern will never have any resemblance whatsoever to the sensory one, the connection between the two being entirely arbitrary, so far as similarity of process is concerned. The pattern of the impulses in the pyramidal neurones will determine that in a larger number of fibres which innervate the skeletal muscles and in turn will govern the behavior pattern, or the posture and movements of the organism. All along the course of the conduction from the object to the "effect," there is a continuous and at many points radical modification of the pattern, but, nevertheless, the pattern in each stage determines that in the next following stage, working of course in conjunction with the inherent structures which characterize the stages in question.

The pattern of the response on the entrant or sensory side of the cerebral cortex is correlated very closely with the psychical pattern, or configuration which is found in the accompanying consciousness. This psychical pattern is identical, as a rule, with the object, as the latter is presented in consciousness. It bears, however, only a remote resemblance to the physical object which initiates the response.

Now the transformations of response patterns which occur between the object and the brain are of great technical interest in general physiology, but the transformation which is of primary interest in the theory of motivation is that occurring between the entrant and the emergent brain processes. This is the relationship which determines the *specificity* of the response. From the standpoint of the brain, it is quite immaterial how the entrant activities are determined, and from the standpoint of the specification of behavior the only thing which counts is the form of the impulses which leave the centers. In order to understand behavior, we must know how the input and output phases of the central activity are associated, and what the specific causes of such association are in particular cases. For example, suppose that we react to an apple by taking a bite out of it. This involves a linkage of the cortical representation of the apple with a complex series of motor innervations which are prerequisite to the grasping of the apple, the lifting of the same to the mouth and the application of the teeth thereto. General physical principles do not enable us to infer the behavior from the object, so that we shall be forced to appeal to the peculiar structure and properties of the cerebral machine.

55. *Levels of Response Transfer*

Before proceeding to attack the problem thus suggested, we must consider certain other features of the response mechanism, particularly as it exists in human beings. In studying the operations which occur in complex nervous systems, we find it necessary to distinguish between a number of *levels* of central transfer or adjustment. Such a plurality of levels involves the possibility of conduction from the afferent to the efferent sides through more than one junction point. There is a network, so to speak, of long and short circuits. In the human being, the shortest circuit occurs through the centers of the spinal cord, or of the medulla oblongata, and involves the minimum number of neurones. The longest circuit is through the association areas of the cerebral cortex, along which path a very large number of neurones may be concerned in serial order. Intermediate transfer levels occur in such portions of the nervous system as the thalamus, the mid-brain, and the cerebellum. There are also alternative paths of conduction, which involve more than three conductors, even within the spinal cord.

The distinction between the short and the long circuit centers corresponds to that between *lower* and *higher* nerve adjustment mechanisms. These adjectives are used for several reasons. Firstly, the adjustments which occur through the longer circuit paths are more complex than those occurring through the shorter circuit ones. Secondly, the former are the result of a later evolutionary development than are the latter. Thirdly, the higher central processes are directly associated with conscious states, whereas the lower ones are only indirectly so associated. Finally, it happens that the long circuit centers are actually located in the upper portion of the nervous system in the erect human being.

If we approach the problem of motivation from an entirely unbiased physiological standpoint, our interest lies in an explanation of the specificity of all kinds of response whatsoever. We shall be just as much concerned as to why irritation of the nose results in sneezing as in an understanding of why traffic officers react with harsh language to the infringement, by automobile drivers, of the rules of the road. From the physiological standpoint, complex voluntary action is no more needful of explanation than is the simplest reflex reaction. Moreover, the general type of explanation which must be given may be the same in both cases, differing only in complexity. We wish to know, first, the exact nature of the mechanism which connects the ingoing and outgoing nerve currents; and, second, how this connection was established. However, if we approach the problem from the psychological angle, we are apt to be interested only in those forms of behavior which are definitely determined by adjustments made in the higher brain centers, since these are the only ones which are represented in consciousnss.

The layman, as we have already noted, limits his interest further within the domain of voluntary behavior to uncommon forms of response. But for us the problem is perfectly general. Nevertheless, the largest number of problems and the greatest difficulty of explanation are found in connection with those adjustments which occur through the intermediation of the cerebral cortex, the highest of all nerve centers, so that we must devote particular attention to the properties of this organ.

56. *The Functions of Various "Nerve Centers"*

In order to understand the functions of the cerebrum, it is necessary, however, to have a clear knowledge of the general nature of the lower nerve centers. The spinal cord, as the lowest of these centers, contains the essential junction points for a large number of bodily reflexes which can occur quite perfectly without any participation by higher regulative centers, although they may be subject to interference or reinforcement through the action of the latter. The cord also acts as a conduit through which impulses are conducted from the body surface and internal organs to the brain. The functions of the medulla oblongata, which connects the spinal cord to the brain, are similar to those of the cord, but involve reflexes of the head-end of the body and the regulation of the more vital processes, such as those of circulation and respiration. The *cerebellum,* which is a portion of the brain adjacent to the medulla, receives afferent nerve impulses primarily from sense-organs located in the motor apparatus (muscles, tendons and joint-surfaces) and from the equilibrium sense mechanism of the inner ears. The efferent impulses which leave the cerebellum pass to all portions of the voluntary musculature, and are concerned in the automatic maintenance of tension and coördination between the various muscular units. The cerebellum appears to be a device for adjusting the details of motor innervation, usually under the guidance of the cerebral cortex. It is possible that it is endowed by heredity with a stock of "records," which enable it to produce and reproduce specific types of motor reaction when circumstances demand them, although these reaction forms are not linked with any definite stimuli. As examples of such reaction forms, we may consider some of the items on James' list of simple instincts: "sucking, biting, chewing, licking, grimacing, etc." However, the prime duty of the cerebellum seems to consist in the maintenance of tonus and balance throughout the voluntary musculature.

In the mid-brain, which is enveloped by the mass of the cerebrum, we find further regions of reflex transfer, which, however, are usually more complex and variable in their action than is the case with the centers of the spinal cord or medulla. The *thalamus,* which is an important portion of the fore-brain, forms a kind of vestibule to the cerebral cortex, since practically all of the sensory nerve currents which are destined for the cortex, pass through the thalamus. Here, also, is found a synaptic center for all of the pain nerves of the body, and many of the mimetic expressions of instinct or emotion are probably controlled directly from centers in this general region of the brain. There is a very definite interaction between the thalamus and the cerebral cortex in regard to pain impulses, and possibly also with reference to impulses which give rise to pleasure. Concerning this relationship we shall have a great deal more to say in later chapters.

The cerebrum is by far the largest portion of the brain in the human being although it is practically absent in many lower vertebrates. It consists of a very intricate network of conducting fibres, which have myriads of junction points, located for the most part in the surface of the organ, a large part of which is adjacent to the bony case of the skull. The convolutions and fissures in this surface appear to have the function of increasing its area to a maximum. The cerebrum is divided, right and left, into two halves known as the cerebral hemispheres. The right hemisphere is connected almost exclusively with the left side of the body, while the left hemisphere deals with the affairs of the right side.

The cerebral cortex receives a very large number of nerve fibres from all of the sensory surfaces of the body and also gives rise to fibres which pass to all of the skeletal, or so-called voluntary muscles. These fibres are segregated and distributed to special zones, known as projection areas. Thus, we have surfaces in the cortex which are exclusively for visual, for auditory, for olfactory, for tactual, for motor impulses, and so on. The motor area is devoted to the transmission of impulses along the pyramidal neurones. These sensory and motor projection areas by no means exhaust the entire surface of the cortex, and it is natural to suppose that the remaining and intervening parts will be employed for purposes of *association* between the sensory and motor zones. This supposition has *already* been corroborated to a convincing extent by empirical observation. It is evidently in the association areas of the cortex that we should look for the principal basis of specificity in voluntary behavior.

Chapter VI

Determining Factors in Reflex Response

Let us continue to adhere strictly to our physical point of view regarding response, and endeavor to arrive at a preliminary understanding of the factors which must determine its *specificity*. The reader is reminded that the concept of response specificity (as defined by Holt) comprises the identification, or selection of a particular kind of reaction (behavior) as a constant function, or accompaniment of a particular object which acts so as to stimulate the nervous system. Reduced to mathematical form, the specificity is represented by a functional equation, such as $R = f(O)$, where O is the object and R is the effector reaction. Although such response functions can seldom be expressed in quantitative form, their logical nature is not affected by this limitation. The statement: "Johnny always cries when he sees a dog," is a functional formulation of this sort which indicates the specificity of Johnny's response to a dog.

57. *The Notion of "Drive"*

The majority of psychologists have felt that even on the physiological side, motivation involves something more special than a mere account of the mechanism through which the reaction is determined by the object or stimulus. Woodworth, for example, in his *Dynamic Psychology,* says that the mechanism shows "how" it is done, whereas for a complete motivational account we require an answer to the question as to "why" the specificity exists. Distinctions of this sort appear to be very helpful as aids to popular exposition, but they must be regarded with considerable suspicion if our purpose is to adhere strictly to scientific analysis. If we are considering the operations of a machine, such as a printing press, the question of "how" would seem to exhaust the problem so far as the inherent factors in the process are concerned. If we ask "why" the printing press acts as it does, we may mean a number of different things. In the first place, it is possible that we are interested concerning the manner in which ultimate mechanical laws control this particular device, but the answer to this would necessarily be embodied in that to the question, "how?" Secondly, we might interpret the question, "why," as a reference to the purposes or ideas of the operator, the owner, or the inventor of the machine. In this case, we should be going beyond the problem which is immediately before us, and introducing irrelevant considerations. A third interpretation might lead us to a study of the electric motors, power lines, dynamos, steam engines, and so forth, which energize the press. It is this latter meaning which seems to be paramount in the minds of such writers as Woodworth and McDougall. They feel compelled to regard the nervous mechanism as being essentially inert, requiring some outside source of power to keep it in motion.

Although this proposition may actually apply to the operations of some response mechanisms, we are by no means justified in viewing it as a general necessity. The division of a machine into inert and activating parts may be a helpful mode of analysis, but it is, nevertheless, arbitrary. If we consider a steam engine, for example, as comprised not only of so many metallic parts, but of red-hot coals, boiling water and steam, then the mechanism is self-activating, and the question as to why it moves is answered by a complete analysis of its inherent nature and properties. Now the neuromuscular systems of animals appear, at least superficially, to be self-activating, or energizing devices of this sort, which may be controlled by external agencies but which do not need to draw upon the latter for power. The familiar comparison of the nerve impulse to the ignition of a train of gun-powder illustrates this principle.

In the last analysis, the notion of *drive* as advocated by Woodworth, McDougall and others can undoubtedly be given a distinctive interpretation, but in beginning the attack upon the problem of motivation, we cannot limit the investigation to a search for "prime movers." The question in which we are interested is the much broader one of the total structure and process which determines the specificity of response or gives rise to any observable effector reaction. However, it is certainly legitimate to add to this question the one as to the *historical foundation,* or origin of the structures which underlie this total structure and process. This is particularly pertinent in the case of a mechanism such as the nervous system, which is subject to significant changes at every moment throughout its existence. The answer to the question as to the origin of specific response mechanisms is another possible interpretation of the answer to the question, "why?"

Perhaps objections may be raised to these views on the ground that they unduly generalize the problem of motivation. It may be said that we can distinguish clearly even on a purely physiological basis, between pure reflexes and the more complex forms of response which are usually indicated by the term, behavior. It may be said that there is no question of motivation in a cough, but that the cigarette habit may require a motivational explanation. However, as we have already pointed out, it is hardly safe to start with distinction of this sort, since we may eventually discover that the fundamental principles which control reflexes and habits are the same, at least in part. The elimination of the simpler forms of response from the problem of motivation can really only be justified from the standpoint of a psychological definition, in which the relation to consciousness is made the determining feature.

58. *Anatomical Conjunction in Response Specificity*

Let us therefore begin our analysis by an inquiry into the mechanism of a typical "simple reflex." Such reflexes are exhibited in a particularly clear manner in the "preparations" which result from surgical operations upon the nervous system of such animals as the dog or cat. It is readily possible to sever the spinal cord from other portions of the nervous system in these animals and yet to maintain life and functional activity in the lower nerve centers. In such an animal preparation—a spinal dog or cat—the spinal reflexes can be evoked with great regularity, and their properties can be studied quantitatively. If the higher nerve centers are entirely cut off, we are not disturbed by thoughts concerning any influence which might be exerted by the "psyche" of the animal. As an example of processes of this sort, we may consider the "scratch reflex" of the spinal dog, as studied by Sherrington [109] and others. This reflex is set off by a tactual stimulation (tickling or rubbing) of the skin of the dog's back and the reaction consists in a scratching movement of the hind limb which applies the claws to the stimulated point. Although the reaction is fairly reliable, the intensity of stimulus which is required to bring it out varies from time to time.

Before proceeding, however, to consider variations in the sensitiveness, or intensity of the reflex, we may first inquire as to what feature of the organism is responsible for the existence of this specific response under any circumstances. The answer to this question is quite simple and direct. It is that the evocation of the scratching movement, upon stimulation of the skin receptors, is referable primarily to the *anatomical conjunction* of appropriate afferent and efferent neurones in the spinal cord. This anatomical conjunction operates in the nervous system just as does spatial proximity in any conducting arrangement, such as a network of electrical wires. The nerve currents flow along the paths of least resistance, which are determined by the continuity, or relative continuity of the nerve tracts.

Although we may not be led finally to adopt an "anatomical conjunction theory of motivation," nevertheless we must recognize that this relationship is a prerequisite of all specific response and must be regarded as one of its primary determining factors. When we come to consider the mechanism of the cerebral cortex, we shall see how it is possible for anatomical conjunction to become so ubiquitous that it defeats its own ends and makes another principle paramount. However, in the case of the spinal and other reflexes, there can be little doubt that it is an important selective factor in determining the motor result which follows from the given form of stimulation. The dependency of specific action upon proximity of parts is not only a feature of conducting networks, but also of machines in general. In the case of a single neurone, or conducting nerve unit, the continuity of the unit is really nothing but an intimate juxtaposition of its constituent molecules. The nerve units, in turn, are juxtaposed at the *synapses,* which are in the nature of switches, or contact points. Assuming the continuity of the individual units, their synaptic connections become the crucial determining features. Hence if anatomical conjunction were the whole story, the synaptic diagram would provide us with the entire explanation which we are seeking.

59. *Intensity Factors in Reflex Control*

However, a study of even the simplest of reflexes shows that the existence of an appropriate nerve-net is not the only thing which underlies the process. In the first place, the *intensity* of the stimulus plays an important part. The reflex is not aroused by all intensities of the stimulus whatsoever, but requires a certain minimal intensity, which is known as the threshold. If the intensity is increased beyond this value, the vigor of the reaction will also be augmented until a limiting condition is reached. This quantitative variation in the reflex may not be considered to be of very great interest when only a single reflex tendency is in operation, but when two or more tendencies are aroused simultaneously and come into conflict, the ratio of their intensities may determine the outcome. In this case, we have to regard the intensities of the stimuli, or of the reflex tendencies themselves, as the determining factors for the resultant response.

In this connection we may note another complicating feature, namely, that the intensity of the reaction is not deducible from that of the stimulus by any simple law such as that of the conservation of energy. The nerve current does not consist merely in the propagation, along the network, of energy or tension which is applied to it by the stimulus. Frequently the energy of the latter is excessively minute, and is only sufficient to pull a trigger which liberates the inherent energies of the nervous apparatus, and these continue the process. Furthermore, the forcefulness of the response activity at any point along the conduction is to a very large extent a function of the latent energies of the nerve mechanism at this particular point. That this is true will be clear from a consideration of the simple fact that muscles exert forces of many pounds, whereas the forces of the nerve current can only be measured by the use of delicate electrical apparatus. Nevertheless, these considerations do not disturb our conception of the response process as a propagation of a disturbance from one point to another along a predetermined path. They mean only that we may be forced to compare the response chain to a telephone system involving a cascade of amplifiers, rather than a simple line of wire.

60. *Qualitative Factors in Reflex Control: Chronaxy*

Nevertheless, there are still further complications which must be introduced even in the case of a so-called simple reflex. Anatomical conjunction is not the only feature which determines the exact path which is taken by the response currents. Even in the stimulus stage of the process, we can demonstrate the dependency of the path upon the intensity or quality of the stimulating force. If we act upon the skin of the dog's back with forces different from those of rubbing or tickling, we are liable to bring out reactions which differ from scratching, since these different forces may be picked up by other kinds of receptors, and may not excite those which are connected with the scratch mechanism. If we subject the organism to the action of light, we shall naturally arouse only those reactions which can be set off through the optically sensitive organs, the eyes, regardless of the fact that the light may be incident uniformly upon the entire bodily surface. In the same way, a low degree of heat will evoke only reflexes which are associated with the heat-sensitive receptors. A high degree of heat, however, may involve the response of pain nerves, which are also aroused by other stimuli which threaten the skin with injury. Thus there is a *filtering action* of the receptors with reference to different kinds of stimuli, at the very outset of the response process, so that the exact character of the reaction will depend not only upon the anatomical point of incidence of the stimulus but also upon its qualitative (and quantitative) nature.

This principle of the determination of the exact response path through filtration, resonance, or some similar action is of fairly obvious application at the stimulus stage, since the differences which are involved can usually be incorporated in our definition of the object,—of which we regard the reaction as a function. There is, however, plenty of evidence that similar principles are operative in subsequent stages of the response where their exact nature is not so apparent. It is necessary to have recourse to these principles to explain certain directional features of conduction which do not seem to be completely accounted for by anatomical conjunction. For example, in the case of the scratch reflex, we find that there is a general innervation of the class of muscles known as flexors, regardless of whether they are attached to the ankle, the knee, or the hip of scratching limb. In the case of a different reflex, which is known as the *extensor thrust,* another class of muscles, the extensors, is involved. It is likely that this selection of particular classes of motor apparatus is not wholly due to the more anatomical conjunction of the corresponding neurones, but depends also upon the special character of the afferent nerve currents, which spread semi-diffusely through the spinal cord and arouse only those output mechanisms which are particularly sensitized, or resonant to the given afferent currents.

If we endeavor to picture more exactly the mechanism of this process, we may be tempted to utilize Hartley's notion of resonance in nerve centers, particularly since it has been shown experimentally that the nerve current is pulsatory, or intermittent in character, somewhat resembling an alternating electrical current (including radio frequency disturbances). Accordingly, it might seem that we have only to suppose that nerve centers, synapses, or points at which outgoing currents are set up, can be tuned to certain frequencies of nerve vibration, just as we tune a radio set. A selective radio receiver can be subjected simultaneously to a vast number of different waves, coming from many broadcasting stations, but will respond only to the one with which it is in resonance. Another radio receiver in exactly the same environment, but differently tuned, will respond to quite a different wave. Mechanical devices analogous to muscles, might readily be activated by the response of such radio receivers.

However, the nervous current is not exactly comparable to an alternating electrical current, and the principle of resonance cannot be applied to it in the same form which is applicable to alternating or radio currents. Nevertheless, a modified principle, that of *syntony*—as defined by Lapicque—can be utilized. According to this view, each neurone or muscle exhibits a natural temporal course, or speed of process which Lapicque [110] calls *chronaxy*. If stimuli are applied to the unit at a rate which corresponds to this chronaxy, the unit is aroused much more readily than would be the case if the rate, or temporal character, were different. A muscle fibre and its attached motor neurones are said by Lapicque to have the same chronaxy; and an afferent nerve of similar chronaxy would more readily arouse this syntonized motor unit than would some other afferent nerve having a different chronaxy.

61. *Variations in Reflex Sensitivity*

Now another class of factors which enter into the determination of a reflex are those which influence its sensitivity, or threshold. Perhaps the simplest of these is exemplified in the principle of summation of successive stimuli. A brief stimulus may be quite inadequate to arouse a reflex, but at the same time it increases the sensitiveness of the system to the action of a second brief stimulus, and this effect accumulates until the reaction appears. Thus, the history of stimulation during immediately preceding intervals may be a factor in determining the effectiveness of a stimulus. An influence which is the reverse of summation is found in phenomena of fatigue or refractory phase. Fatigue may occur in the receptors, due to the continued action of the stimulus, so that adequate afferent nerve currents are not set up or, on the other hand, it may be localized at the central, or synaptic point and interfere with the arousal of the motor sector of the reflex arc even when the afferent sector is operating normally. Refractory phase is a temporary condition, immediately following the discharge of the motor tendency, under which it is very difficult to rearouse the response. The degree of difficulty may vary from complete impossibility, during the period just subsequent to the discharge, to a relatively slight increase in difficulty later on when the normal condition has nearly been reëstablished.

Although the continued exercise of the nerve center causes fatigue, at a much later time an *increase of sensitivity* may be noted as a consequence of exercise. In addition to these influences, we must also consider the effect of changes in the chemical constitution of the lymph which surrounds the nerve cells. The presence of such drugs as alcohol, strychnine, or morphine in these fluids has a tremendous influence upon the central response to afferent nerve impulses; and variations in the oxygen and carbon dioxide content are also accompanied by important alterations of sensibility. Lack of oxygen tends to prolong the refractory and fatigue phases, while strychnine greatly increases the excitability. Different nerve centers or transfer points exhibit different degrees of sensitiveness to such chemical agencies, so that the chemical condition of the medium may determine the outcome of a conflict between two simultaneously aroused response tendencies.

62. *Special Properties of Reflex Centers*

In general, we do not find it possible to explain either the spatial, or the temporal structures of the reaction by reference merely to those of the afferent portion of the response process. In the case of the scratch reflex, the stimulus may be substantially continuous in its action, whereas the innervation of the leg muscles is intermittent, so as to produce the scratching movements. Consequently, we must suppose that the central or motor elements are equipped with a device for generating intermittent or alternating action, on the basis of a continuous innervation from the afferent side. Sometimes, however, the explanation lies in the fact that the first phases of the motor process bring new afferent impulses into existence which combine with the original ones in a systematic manner to modify, or control, the course of the reaction. In the phenomenon known as *after-discharge,* which is characteristic of reflexes, the reaction continues for some time after the stimulus, and presumably the afferent nerve current, have ceased.

The properties of reflexes which we have considered above distinguish them to a considerable extent from simple nerve conduction of a non-reflex character. This latter type of conduction is that which occurs between points in a single neurone, or fibre, a process which is not observable in isolation in any of the complex organisms, but which must nevertheless be regarded as a component feature of any response, however complicated. Consequently, the distinguishing characteristics of the reflex must be attributed to some constituent of the reflex arc which is additional to the individual neurones which enter into it. Sherrington believes that this feature consists in the *synapses* or junction points between the afferent and efferent conductors. As compared with plain nerve fibres or "nerve trunks," synapses must therefore be supposed to possess the following properties which are shown by reflex mechanisms:[111] (1) slow speed of response, especially in the form of a prolonged initial delay (latent period), (2) extensive after-discharge, (3) lack of correspondence of rhythm of stimulus and effect, (4) lack of correspondence between the intensity gradations of stimulus and effect, (5) resistance to a single stimulus, combined with a summation of the effects of successive small stimuli, (6) conduction only from afferent to efferent, (7) relatively great fatiguability, (8) relatively great general variability of the threshold, (9) very long refractory periods, (10) great dependency upon oxygen and (11) relatively great susceptibility to the action of drugs. These characteristics may be summarized by saying that the synapse appears to exhibit greater inertia, and resistance to the passage of a nerve current than does a continuous single nerve fibre, or group of such fibres operating in parallel.

The conception of a synapse as consisting merely of a junction point between an afferent and an efferent conductor, is undoubtedly altogether too simple. It is highly probable that such junction points can possess peculiar and complex properties which differentiate them from the conjoined neurones. In particular, we can readily understand how they can exhibit an increased resistance to the passage of nerve impulses, since there is an apparent break in the continuity of the conducting tissue at the synaptic points, so that the impulse has—so to speak—to leap across a gap. However, it is almost certain that in the majority of reflexes, special central nerve mechanisms are concerned which involve centrally located nerve cells as well as junction points. Nevertheless, such central mechanisms may be regarded as being interpolated between the afferent and efferent structures and as being logically separable from either of the latter. The most convenient general term for this central mechanism, including the synapse, is Professor Parker's concept of the *adjustor*.[112] It will of course be realized that in any concrete reflex a very large number of synapses must be operative simultaneously, all of these with their complex interrelations being comprised in the adjustor process or structure.

63. *Inhibition*

The synapses, or adjustors, are ordinarily mechanisms by which a nerve current or excitation is passed positively from an afferent to an efferent channel, although usually with radical modification in the nature of the process. However, it appears that in certain cases the action of the synapse, or adjustor is algebraically opposite to excitation, producing an effect known as *inhibition*. Inhibition is not merely a failure to excite, but involves a repression or blocking of excitations which would otherwise have occurred. The process of inhibition is of particular interest in connection with the interaction of two or more reflexes, since it is a prerequisite to the creation of conflict between them. However, a central inhibitory effect is found even in the case of single reflexes. For example, such a movement of the hind limb of the dog as is involved in the scratch reflex, requires not only an excitation of the nerve fibres which energize the *flexor* muscles, but a simultaneous inhibition of the fibres controlling the *extensor* muscles, which are mechanically opposed to the flexors. Accordingly, the adjustor which is in control of this reflex must inhibit the extensors while it is exciting the flexors, and there is conclusive evidence that the inhibitory effect occurs within the spinal cord, rather than in the muscles.

64. *The Interaction of Reflexes*

If the neuromuscular system of an organism contained only a single reflex mechanism, the problem of motivation would be solved for it by an understanding of factors exclusively of the character above discussed. Possibly an organization as simple as this can be demonstrated in certain sensitive plants. In the case of such an organism, having but a single reflex, we should merely need to inquire concerning the presence or absence of the specific stimulus, its intensity and point of application, and the contemporary state of the adjustor mechanism of the reflex. Whenever the reaction was observed to occur, we could explain it by demonstrating the existence of the appropriate object or stimulus. If the reaction should fail in the presence of the object, we should look either for some peripheral factor rendering the latter inoperative, or for some reduction of sensitivity on the part of the adjustor, or other stages of the mechanism.

However, there is, perhaps, no animal organism—even among protozoa, which possess no true nervous system—in which the science of a single reflex would serve to account for all behavior. An organism such as that of any vertebrate, possessing a very large number of reflex mechanisms, will frequently be subjected to stimuli which tend to arouse a number of them simultaneously. In this case two general possibilities appear. First, two or more reflexes may occur together in comparative harmony or, second, they may interfere with one another in such a manner that certain of the stimulated reactions are suppressed. In this case we have a situation closely resembling that which is usually contemplated when the question of motives is raised in connection with human voluntary behavior. The individual is pressed by a number of different forces, and frequently has to make an exclusive choice between them as regards his behavior. However, it sometimes happens that two or more stimuli give rise not merely to reflex tendencies which do not interfere, but which are positively helpful to one another, so that we must speak of *allied* as well as of *opposed* and indifferently related reflex mechanisms.

It therefore becomes of great importance to understand the factors which control the combination of reflex tendencies, and, in particular, the outcome of interference between such tendencies. This topic is the one to which Sherrington has made so many contributions in his doctrines of the "integrative action of the nervous system." The alliance or opposition of reflexes is ordinarily attributable to their use of the same motor apparatus, including the efferent neurones. Such neurones constitute, in the Sherrington terminology, the "final common path" of the reflexes in question. When the reflex adjustor mechanisms tend to energize the common path in the same manner, there is a strong probability of alliance. As an example, we may consider what happens when the scratch reflex of the dog is stimulated from two different points on the skin of the back. In this case the reaction is usually stronger than it would be if only one of the points had been affected. Sherrington [113] regards this situation as involving two logically separable scratch reflexes, a view which may be justified by the fact that the reaction ordinarily applies the claws to the spot which is stimulated, and, so, is specific with respect to this particular region. The degree to which the two stimuli reinforce each other is in fact proportional to their proximity on the skin. However, it is possible to find widely divergent forms of sensory excitation which are capable of combining in the production of a single reaction. For example, simultaneous stimulation of the skin of the foot, and of the sensory nerve of the so-called ham-string muscle contribute to the same muscular action, which consists in a flexion of the leg. It is even possible to demonstrate a general tendency for sensory excitation at any point whatsoever in the body to reinforce any concomitant motor process, although of course this tendency has many specific exceptions. Inhibitory processes, also, may combine so as to reinforce one another in their repressive effects.

Reflex mechanisms which are not compelled to utilize the same final common path may occur simultaneously without either reinforcing or opposing one another. Thus, wagging of the tail and the scratch reflex may, in the case of the spinal dog, occur together without either aiding or interfering with each other. Similarly, in the normal human organism, constriction of the pupil of the eye bears no appreciable relationship to the reflex of coughing, so that the two may occur simultaneously without interacting.

However, in many cases we find that reflexes which are lacking in final common paths, nevertheless, do actually have a bearing upon one another, as a consequence of their organization into some more complex system of response. For example, the reflex movements of the stomach are inhibited when the "instinct" of fear is aroused, although the motor expressions of fear are not primarily gastric in nature. Moreover, as Sherrington points out, neutrality between reflex actions tends to disappear as the processes in question increase in intensity.

65. *Factors Deciding Reflex Conflict*

The most interesting relationship, from our present point of view, is, however, that which obtains between *antagonistic* reflexes. The adjustor mechanisms of such reflexes are set to use the same final common path, in different ways, so that it is physically impossible for them to operate simultaneously—at least to any good effect. However, their interference is based upon a nervous rather than a physical incompatibility. The evolution of the nervous mechanism has evidently been such as to guard against the simultaneous arousal of inconsistent reactions, which could lead to no useful result. As an example of such interference we may consider what happens when the scratch reflex and the so-called flexion reflex of the hind limb of the dog are simultaneously excited. One of these reactions demands a steady flexion of the limb, while the other requires alternate extension and flexion, so that the two cannot occur at the same time. As a rule, the scratch reflex is suppressed, and steady flexion becomes dominant when these two mechanisms are simultaneously aroused. This is attributed to one of the fundamental principles which determine the outcome of reflex conflicts, and which we shall consider below.

Sherrington [114] enumerates four different classes of factors which govern the outcome of a conflict between opposed reflex tendencies. The first of these consists of "spinal induction," of which there are two kinds, immediate and successive. *Immediate spinal induction* is a process of alliance and reinforcement operating between similar reflexes. In accordance with the principle of this process, the reflexes which are in conflict may be assisted to win by their allies. "In union there is strength." In a complex organism, a contest is usually staged, not between physiologically simple reflexes, but between *groups* of associated reflex mechanisms. *Successive spinal induction* is a rather different kind of process, which has the status of an after-effect of inhibition. If a given reflex tendency has been inhibited, it is liable to reappear with augmented strength when the inhibiting force is removed. For example, stimulation of the flexion reflex lowers the threshold of excitation for the extensor muscles, which are inhibited during flexion. This "rebound" action can also be observed quite readily in the more complex forms of human behavior.

Another important determinant of the issue of a conflict between reflexes is found in the factor of *fatigue*. Continued repetition of a reflex process decreases the facility with which it is aroused, so that a reflex which is in the fatigued state will be more readily overcome by a second reflex agency. Two reflex mechanisms which are unequally fatigued will tend, in a conflict, to be successful in inverse proportion to the degree of their fatigue. The locus of the fatigue is probably in the synapse or adjustor, although in some cases it is sensory. In the situation which we are considering, the fatigue is not localizable in the muscle, or in the motor nerves (final common path). The condition of refractory phase may also act in a manner similar to that which is characteristic of fatigue, although the former condition is of such shorter duration. Lack of oxygen or the presence of drugs may produce analogous effects, depressing or enhancing conflicting reflex forces unequally, and hence affecting the outcome of the struggle.

Sherrington regards the *relative intensities* of the conflicting reflexes as the most powerful determinants of the issue of a conflict between them. The intensity of the afferent process depends primarily upon that of the stimulus, so that a reflex which is aroused by a weak stimulus will tend to be dominated by an antagonistic one having a stronger stimulus as a cause. However, the sensitiveness of the sensory mechanism, and the size of the afferent nerve, must also be considered. The smaller the number of fibres in the nerve, the lower its power usually is over the effectors. Moreover, afferent currents which are aroused at a considerable distance from the effector, which they seek to control, are at a disadvantage when in conflict with reflexes having a shorter path. Other features can, perhaps, be found which enter into the determination of the intensity of the conflicting adjustor processes, and which may thus have a bearing upon the outcome of the combat.

66. *Reflex Prepotency*

From our present point of view, the fourth determinant of the issue of a conflict, as listed by Sherrington, is probably the most interesting of all. It consists in the *species or kind* of reflex which is involved. Certain classes of reflexes exhibit very superior strength when they come into conflict with reflexes belonging to a different class. Among such very potent—or "prepotent"—reflexes are those which are aroused by stimulation of sense-organs which Sherrington [115] classes as *nociceptive*. These are receptors, or sense-organs which respond specifically to injurious stimuli, their most important exemplars being the receptors of the pain sense. It is natural that the reflexes which are set off by pain stimulation should dominate over those which are aroused by innocuous stimuli, such as mere contact, since an appropriate reaction to the former is of vital importance to the welfare of the organism. The dominance of the flexion over the scratch reflex, which we have already mentioned above, is explained by this principle of the prepotency of nociceptively aroused reactions, since the flexion reflex is a response to a needle prick, whereas the scratch reflex follows from a harmless touch. However, if the pain stimulus is sufficiently weak and the tactile one sufficiently strong, the scratching action may appear, and become dominant over the continuous flexion process. Nociceptive reflexes show a tendency to persist in the face of general disturbances of nervous activity which obliterate many other reflex processes, thus showing the peculiar vitality of the former types of response.

Sherrington points out, furthermore, that any reflex arising from the stimulation of receptors which can produce strongly pleasant or unpleasant (affective) consequences in consciousness, tends to prevail over other types of reflexes in the case of conflict. He calls such reflexes in general "pseudaffective." The sexual reflexes, such as the embracing reaction in the case of the male frog during the breeding season, show a prepotency as great as, or greater than that which is exhibited by nociceptive reflexes. In order to complete our terminology, it seems advisable to invent the adjective, *beneceptive,* to designate sensory processes and attached reflexes which are of the character of the sexual responses, as contrasted with those of pain. Nociceptors may be defined as sensory cells, or afferent mechanisms, which are particularly attuned to injurious agencies; whereas beneceptors may be considered as similarly qualified with respect to especially beneficial environmental, or organic, conditions. We can then say that reflexes which are aroused by the stimulation of either nociceptors or beneceptors tend, other things being equal, to dominate over the motor tendencies appertaining to other forms of sensory excitation.

Sherrington points out that all of the factors which control the outcome of conflicts between reflex arcs apparently can be interpreted as different grounds of response intensity, presumably in the adjustor stage of the reflex. This applies not only to the influence of spinal induction, fatigue, and stimulus magnitude, but also to the *species* of reflexes, since it seems highly probable that the nociceptively and beneceptively aroused adjustor processes have a high degree of nervous power. This is evidenced by the fact that their normal, unimpeded expressions show great strength and persistence. The conflict of response tendencies is therefore fundamentally a quantitative affair, in which the result is dependent upon the comparative magnitudes of the positive and negative forces which are operative. For it seems that each response tendency must be capable of acting both positively and negatively: positively in seeking its own expression, and negatively in opposing the expression of its antagonists.

67. *Successive Reflex Combinations*

Sometimes reflexes which are antagonistic to one another, when simultaneously aroused, can combine harmoniously *in succession.* Some of the commonest movements, such as walking, involve a rhythmic succession or alternation of antagonistic reflexes: flexion followed by extension, or the like. It has been shown that, in certain cases, the motor process of extension itself arouses the reflex of flexion, or vice versa, so that an orderly sequence results. The notion of a chain of reflexes, so arranged that the motor phase of one member generates the stimulus to the next member, has frequently been advocated as an explanation of complex acts of a seemingly instinctive nature. Reflexes may be combined into more complex response systems either in this manner or because their respective stimuli are simultaneously provided by the environment.

Chapter VII

Hereditarily Determined Specific Responses

Let us now consider what particular aspects of human or animal behavior can be explained in terms of reflex mechanisms such as we have outlined in the previous chapter. The forms of response which can be included under this classification will be primarily hereditary in their determination, since they must depend principally upon anatomical arrangements of neurones which are built into the organism at birth, or which develop as an inevitable consequence of congenital forces. The factors which may be involved in addition to anatomical continuity, such as threshold, chronaxy, and sensitiveness to general organic conditions, must also be regarded as having an hereditary basis. Nevertheless, we may find that the exercise of such reflex mechanisms, or their interactions with one another, produce significant changes in their operation.

68. *Motor Reaction Units*

Before we proceed to study the specific reflex response mechanisms, we may consider certain purely motor, or efferent systems, which are apparently in-built by ontogenetic forces. The preëxistence of such "reaction units" [116] greatly facilitates the development of learned response because they constitute ready-made coördination systems which can be appropriated as occasion demands by higher nervous centers. Thus, motor learning does not have to begin with a chaos of individual nerve and muscle fibre units, but finds such units already assembled into automatisms, which are approximately correct, in their general character, for voluntary action. These motor units can be conceived as being essentially independent of any particular afferent nerve paths, although it may happen that certain of them are actually connected anatomically with special afferent mechanisms, for the execution of particular reflex movements.

We have already given numerous specific examples of such motor units. In order to find many others, we have only to analyze our own movements (or postures) into gross physiological parts. Consider, for example, the case of the hand. There are several characteristic movements and postures which are possible for each of the fingers and the hand as a whole. Thus, a finger may be flexed, extended, lifted, depressed, or moved either right or left in the plane of the palm. The hand may be flexed at the wrist, either backwards or forwards; the fist may be clenched, the thumb and fore-finger may be brought together (as in grasping an object), etc. Of course, we cannot be certain that all of these possible elementary movements are based upon nervous automatisms; in fact, we may feel quite sure that some of the hand movements result only from prolonged practice which—more frequently than not—is directed towards overcoming such automatisms. Consider, for instance, the difficulty with which we learn to flex the fourth and fifth fingers independently of each other. This difficulty in itself demonstrates the existence of an innate coördinating device which operates to flex all of the fingers at once, although the index finger has a special independent control unit of its own.

It may seem to some readers that such simple movements as are above considered should not require any very special nervous arrangements to permit their execution. However, the necessity of considerable apparatus will be realized when one appreciates that even the simplest of these movements requires the simultaneous and balanced innervation of hundreds of individual muscle fibres, which may have a rather complicated anatomical distribution. In order that a smooth and coördinated movement shall occur, the impulses must not only be distributed to the appropriate outwardly conducting neurones, but they must be suitably regulated both with regard to their temporal course and their intensities.

Now, as a rule, we find that such regulation is not exclusively central in its origin, since ordinarily it involves so-called "proprioceptive" afferent nerve currents. These proprioceptive currents are in a class by themselves among afferent impulses, since they convey information to motor adjustment mechanisms in regard to the outcome of adjustments which have just been made. Therefore, they provide the essentials of an ideal mechanism for muscular control, since the control need not depend arbitrarily upon the activity of the central agency, but may involve the actual state of the motor organ, which reacts upon and modulates the innervations of the centers, through the medium of the proprioceptive impulses. Thus, we can imagine the innervation of a muscle to be throttled by the proprioceptive impulses, which result from its own contraction, in a quantitative manner so that the state of tension in the muscle is due to the balance between the proprioceptive and the essential adjustor energies, which react upon each other at the adjustor point. Now, it seems almost certain that motor regulation devices of this sort, involving proprioceptive impulses as cardinal features, are present in the organism as a direct hereditary endowment. As we have already indicated, the cerebellum—an important portion of the brain—appears to be the natural locus of many regulatory systems of this kind.

As a complement, or correlative of these purely motor control mechanisms, it would not be surprising to find hereditarily founded devices of an exclusively afferent nature, which are an addition to the sense-organs and their obvious nerve channels. The general mechanisms of the sensory side of the cerebral cortex may perhaps be included in this class, and, at a later point in our argument, we shall introduce the notion of further specific arrangements of an afferent character, which provide what we shall regard as "the hereditary basis of learning by experience."

69. *Circulatory and Respiratory Reflexes*

A detailed study of all of the innately determined response specificities would fill a very large book. Consequently, it will be possible here only to sketch a general classification of these responses, and to consider the nature of the more important ones, particularly those which have an intimate relation to complex voluntary behavior. The most illuminating classification of reflexes and of reflex systems is one based upon the biological functions, or utilities, of the responses in question. Although reflexes seem to be mechanistically determined, they nevertheless appear to be purposive in character. This does not necessarily mean that there is any consciousness behind them, but merely that they are of such a character as to assist the organism, or the species in its struggle for existence. In this struggle, there is a fairly small number of essential functions which must be maintained, and the various reflexes can be clustered around these separable functions.

If we begin with functions of the most "vegetative" sort, we may consider, first, the reflexes of *circulation* and of *respiration,* which are designed to supply the tissues of the body with oxygen and to remove carbon dioxide. In the case of the heart—the principal organ of circulation—we find an effector device which is strictly self-activating, the rhythm of contraction and relaxation in cardiac muscle being referable to an automatism of the muscular tissue itself. However, the muscular action is subject to increase under the influence of so-called "cardiac accelerator" impulses, and to decreases due to inhibitory currents. There are many separate sources of these cardiac control impulses: sensory stimuli of various sorts, such as cutaneous pain or internal pressures, direct influences of the blood stream upon the nerve centers, and disturbances coming down from higher levels, such as the cortex (particularly during emotional excitement).

Another closely associated process is that of vasomotor regulation, which controls the distribution of blood in various parts of the body, as well as the general blood pressure. The blood-vessels—with the exception of the capillaries—are provided with muscles which enable them to constrict or to dilate, as the case may require, and these actions are under definite nervous control. This control is based upon a very intricate conducting system. The stimulation of almost any afferent nerve may result in vasomotor changes—usually localized in the vicinity of the corresponding receptors. The effect may be either an increase or a reduction of the volume of blood which is present in the given part or tissue. There are definite vasomotor centers in the medulla and spinal cord, and these are not only generally open to all powerful afferent currents, but also to strong centrally determined impulses. Thus, we find extensive vasomotor changes in states of emotion.

The process of *breathing* seems quite simple, but it actually involves the simultaneous and coördinated action of many different muscles. Inspiration is due to the concomitant lowering of the diaphragm and elevation of the ribs, and is normally accompanied by movements of the larynx and the nostrils. Expiration consists mainly in a relaxation or inhibition of these tensions. When breathing is reinforced, even further muscles are involved. A study of the innervation of the muscles which are concerned in normal breathing shows that it must rest upon coördinated motor discharges proceeding from the spinal cord and medulla at a considerable number of different points; but it has been shown that the control of all of these discharges lies in a definite nerve center in the medulla. This center has an automatic periodic activity—somewhat resembling that of heart muscle—which enables it to energize the breathing apparatus in a rhythmic fashion. However, the nervous discharges from the center are normally under the influence of afferent impulses, derived from the proprioceptors of the chest, and also of impulses coming from higher nerve centers. Furthermore, the activity of the respiratory center is radically affected by the oxygen and carbon dioxide content of the blood, the frequency of the innervation pulses varying automatically so as to keep these concentrations normal. The breathing center provides us with an example of a self-excitatory central mechanism, which is nevertheless influenced in a radical manner by afferent nerve currents and disturbances emanating from the higher centers.

Coughing, sneezing, laughing, crying, and yawning appear to be definite reflexes of the respiratory apparatus, although their functions are not directly respiratory. The first two serve to keep the air passages clear, the second two express pleasure and pain stimulation, respectively, under certain conditions, whereas the last is a form of "stretching" and helps keep the muscles in a lively condition. Coughing is a specific response to stimulation of receptors in the mucous membrane of the larynx, the lungs or the pleura. Sneezing results from an excitation of the nasal branch of the fifth cranial nerve, normally by irritation of the nasal epithelium. Although the two reflexes are very similar in their motor expression, the definite differences between them demand that they should have distinct nervous control centers. Laughing seems to be due to a more or less non-functional excitation of the breathing center by nerve currents released by pleasurable stimuli, which can find no other motor outlet. Crying is a specific reaction to pain stimulation of any kind, ordinarily inhibited in the adult human being. Although the movements of the respiratory muscles are similar in laughing and crying, the accompanying innervations of the facial muscles are quite different, and lachrymation occurs at low intensities of excitation in crying, and only at very high intensities during laughter. Yawning is a reaction to fatigue stimuli, having familiar characteristics.

It should be clear that the reflexes of the circulatory and respiratory systems which we have just considered are not only interesting in themselves, as examples of lower center adjustments, but are of particular significance because of their involvement in processes which are engineered through the cortex. Thus, vasomotor changes were singled out by Lange as the basis of his famous physiological theory of emotion. Breathing and heart action are continuously responsive to the course of cortical activity. Laughter and crying have very special relationships to certain kinds of cortical processes; and even coughing and sneezing assume preëminent positions in relation to higher center control when the respiratory channels are seriously disordered or blocked. We may note that most of these reflexes are far from being "simple," and that their afferent sources are frequently manifold and widespread. Moreover, their motor control mechanisms are usually subject either to excitation or to inhibition by the higher nerve centers.

70. *Alimentary Reflexes*

If we turn, now, to consider the reflexes of the alimentary or nutrition-excretion processes, we find the most primitive ones to be those of *sniffing* and of *sucking*. The first consists in an accelerated movement of the respiratory muscles—particularly of the nostrils—as a consequence of certain olfactory stimuli (which may be sexual as well as nutritional in their significance). Sucking is one of the most perfectly developed of reflexes in the new-born mammal. The stimulus to sucking may consist of contact with the lips, or, at least in the case of the human infant, almost any mild excitation. Animals show a more complex reaction. In the case of new-born kittens, there is at first a sniffing, then clawing with the forepaws, which carries the kitten to one of its mother's teats, at which application of the mouth initiates the sucking reaction.

The act of "deglutition," or swallowing, must be preceded in the case of solid foods by the processes of mastication. The latter are more voluntary than reflex in character, although the general form of the motor mechanism probably has a fairly complete hereditary basis. The movements which are involved in swallowing are initiated by a voluntary act, which forces a bolus of food, the tongue, or some saliva against the back part of the mouth cavity, and the consequent tactual stimulation of nerves in this region sets off the swallowing reflex. The controlling nerve center has been localized definitely in the medulla, and there is a specific interaction between this and the respiratory center, which permits the inhibition of breathing while swallowing is in process.

The contractions of the wall of the stomach, which assist in the digestion of the gastric contents, appear to be controlled by autonomic nerves which are entirely contained in the stomach wall, but they are subject to inhibition by currents emanating from the central nervous system (particularly, the sympathetic section of the autonomic). Such inhibitory effects have been noted by Cannon in the case of the emotional disturbances of anger, fear and pain. The stimulus to the stomach movements involves not only the mechanical influence of its contents, but, also, the chemical condition of the stomach membranes. Another important reflex of the forward portion of the alimentary canal is that of *vomiting*. This comprises a highly complex series of muscular movements, which are participated in by the muscles of the abdominal wall, the diaphragm, and the pharynx, as well as of the stomach itself. The stimulus is usually an abnormal chemical condition within the stomach, but may be olfactory or central in origin. A specific center for the control of this act is said to exist in the medulla.

In addition to the muscular reactions of the forward alimentary system, above mentioned, we must also refer to the glandular reflexes, which include those of salivation and gastric secretion. The first is a reaction to olfactory, or gustatory stimuli, primarily the latter. The efferent nerve paths which are involved are mainly those of the autonomic system. The secretion of gastric juice within the stomach has a rather complex causation. Certain substances, such as meat extract, arouse it directly by contact with the gastric membranes, but it seems to be set off primarily as a consequence of taste stimulation operating through a specific center in the medulla oblongata. When it is once started, it tends to continue over the rather protracted period of gastric digestion, without further peripheral excitation. The adjustments of the "sphincter" muscles, which control the entrance and exit of the stomach, depend primarily upon the degree of acidity of the gastric contents in their immediate vicinity. Although these secretory processes are largely autonomic in regulation, it is noteworthy to what an extent they can be conditioned upon, or inhibited by, the processes of the higher central nervous system; so that physiologists are even impelled to speak of the "psychic factor" in their control.

The "peristaltic" movements of the small intestine are primarily attributable to local processes of excitation and conduction. The muscular tissue itself appears to be capable of carrying out these movements without nervous excitation, but nevertheless they are normally coördinated by the action of a nerve network in the intestinal walls. The movements are definitely inhibited as a consequence of the excitation of the sympathetic section of the autonomic nervous system. The main secretary function associated with intestinal digestion—that of the pancreas—is regulated by the chemical state of the blood rather than by nervous control; a "hormone" known as *secretin* being produced in the intestine by reaction with the acid material which is delivered to it by the stomach, this hormone finding its way to the pancreas and setting off its secretory processes.

71. *Excretory Reflexes*

The characteristic reaction of the large intestine—that of defecation—has a much more definite reflex character. Defecation usually begins as a consequence of a "voluntary impulse," emanating from the cerebral cortex, although it occurs also in animals which have no nerve centers higher than those of the spinal cord. Presence of fecal matter in the large intestine normally gives rise to characteristic sensations—or afferent impulses—which set off the cortical innervation. The first movements involve a contraction of the muscles of the abdomen, with a relaxation and adjustment of other parts, which force some of the feces into the lower portion of the rectum. Here they irritate receptors which start a reflex peristaltic contraction of the intestine and relax the sphincter muscles which normally close the rectum. These reflex movements are controlled through a definite center in so-called "lumbar" section of the spinal cord.

The processes of the urinary apparatus involve a combination of automatic muscular adjustments and definite reflexes. The ureters deliver the fluid from the kidneys to the bladder in consequence of peristaltic movements which seem to have no essential nervous basis; and the muscular wall of the bladder adjusts itself to its contents automatically. When the internal pressure reaches a critical point, due either to the magnitude of the contents, or the compressive effect of the bladder walls, afferent impulses reach the cerebrum which are represented in consciousness by the characteristic "desire to micturate." Nerve currents emanating from the centers may increase the tension of the bladder walls, possibly under circumstances of emotional stress, and thus cause the "desire" when the bladder is relatively empty. The reflex of micturition is probably initiated by the afferent impulses arising from the pressure, and the principal effector action consists in an active contraction of the bladder. In the adult animal the reflex occurs only when released from the inhibitory influence of higher nerve centers. The reflex is controlled through a center in the lower spinal cord.

72. *Reproductive Reflexes*

Although the reactions of the generative, or sexual organs are accompanied by a high degree of psychical—and, hence, cerebral—excitement, these processes are primarily reflex in character. The preliminary stages of erection, or tumescence, in both male and female, depend mainly upon vasomotor reflexes which result naturally from irritation of the sexual parts. It has also been claimed that internal pressure of the seminal fluid against the walls of the vesicles can act as a stimulus to these reflexes; but in the adult, an associative arousal, via the cortex on the basis of visual or tactual stimuli, is the most frequent case. The state of erection provides further stimuli to its own continuation, giving rise to afferent impulses which reach the cortex and correspond to lust sensations in consciousness. Further frictional stimulation of the glans penis, in the male, and the clitoris or the walls of the vagina, in the female, results in an accumulation of tonus in the nerve centers or muscles which finally breaks over into a rhythmic innervation, and the consequent peristaltic action discharges the seminal fluid. The neuromuscular mechanism is fundamentally the same in the two sexes, in spite of the gross differences in anatomy. The controlling nerve centers are located in the lumbar portion of the spinal cord, and the motor fibres form a part of the so-called sacral section of the autonomic nervous system. The processes of *parturition,* or child-birth in the female, also appear to be at least partly controlled by a reflex center in the lumbar cord, the stimulus consisting in some critical change in the relationship between the fetus and the uterus, attributable to the developmental processes of the former. The muscular movements of the uterus which expel the fetus are similar in general nature to other peristaltic contractions which we have considered.

73. *Eye Movements*

Another group of reflexes of an entirely different class are those which control the movements of the eyes. These are extremely complex, both as to their afferent causation and their efferent mechanisms. Definite ocular reflex control centers have been localized in subcortical regions of the brain, but in the case of movements of the eyeballs these centers work in close coöperation with the cortex. The oculomotor processes can be divided naturally into four classes: (1) those of the iris, (2) those of the lids, (3) those of the lens or ciliary muscle and (4) those of the eye-balls as a whole. The pupillary adjustments are on the lowest reflex level, being practically independent of cortical control or interference. The pupillary size depends upon a balance between two neuromuscular forces, those of dilatation and of constriction, respectively. The former seems to be more or less constant, while the latter is determined by the amount of light which falls upon the retinas, so that the pupil diminishes in area as the light increases. The impulses of constriction pass through the cranial, and those of dilatation through the sympathetic, sections of the autonomic nervous system. The winking reflex of the eyelids is set off either by loud sounds or the close approach of an object to the eyes, the control being through cortical or subcortical centers.

The movements of the eye-balls [117] are very complicated and precise. They fall into several types, some of which necessitate a very close coördination of the innervations of the external eye muscles with those of the ciliary and pupillary muscles. One class of eye-ball adjustments is at least partly determined by afferent currents arising from the equilibrium sense-organs of the inner ears: compensation for bodily movements or rotations of the head, or the "nystagmic" eye movements observed in dizziness. The more important innervations, however, are controlled by optical stimuli acting upon the retinas. They bring about convergence of the two eyes and simultaneous focusing of the lenses upon the object of interest in the environment; or they maintain such adjustments by appropriate alterations when the object, or the head, is in motion. "Glancing" from one point to another seems to involve quite a different type of innervation from that of these so-called "pursuit movements." An elaborate system of motor nerve and subcortical centers is devoted to the carrying out of these ocular adjustments, but their principal focus of control appears to be in the cerebral cortex. They fall into a level of nervous organization where reflex and voluntary processes fuse with one another in a very intimate manner. Everyday psychology recognizes clearly the fact that eye movements and postures betray the interests, or cortical tendencies of the individual, and yet the tremendous detail of the innervations which are involved is entirely hidden from consciousness.

74. *The Autonomic Nervous System*

In addition to the above described specific reflexes and reflex mechanisms, there are other hereditarily determined responses of minor importance, which we may find it necessary to mention in later chapters. However, we have still to consider a very important group of reflex effects which result from the innervation of the so-called "sympathetic" section of the *autonomic nervous system.* These effects appear superficially to be rather diverse in nature, but they are united by the observation that they all contribute to the preparation of men or animals for struggle or conflict with danger.

Before discussing these specific reactions, it may be well to say a few words regarding the autonomic system. This system is sometimes described as if it were independent of other portions of the nervous organization which find their controlling centers in the spinal cord or brain; the autonomic system being contrasted with the cerebrospinal system. The autonomic has some self-contained regulatory mechanisms, but it is primarily an efferent, or outwardly conducting nerve-net which is concerned exclusively with the control of processes not involving the voluntary or skeletal musculature. However, the autonomic does differ anatomically, and in the exact manner of its synaptic connections, from the other portions of the central nervous system. Nevertheless, most of the efferent impulses passing out along the autonomic fibres emanate from the centers of the spinal cord or brain.

The autonomic system is usually divided into three portions, the first being located in the head or "cranial" region of the body; the third in the tail or "sacral" section; whereas the second, or "sympathetic" division lies in the intermediate region. The cranial division of the autonomic, as we have noted, carries impulses which bring about constriction of the pupil, the secretion of saliva, the inhibition of heart action, and an increase in the activity of the alimentary canal. It is also concerned in the innervation of the ciliary muscles of the eye, in the regulation of circulation in the skin of the head, and in controlling contractions of the bronchial tubes. The sacral division, as we have seen, conveys impulses which are involved in reflexes of the bladder, the rectum and the sex organs,—and may possibly be regarded as the physiological embodiment of the Freudian "libido."

75. *The Sympathetic System Reactions*

The "sympathetic" or thoracico-lumbar section of the autonomic system is anatomically very complex. It not only receives outwardly conducting fibres from many different segments of the spinal cord, but carries the efferent impulses to a large number of different internal organs. Nevertheless, this entire section appears to operate as a physiological unit. It has, in fact, been demonstrated by Cannon [118] and his co-workers that the innervation of the sympathetic system as a whole is carried out through a definite center in the thalamic region of the fore-brain, a region anatomically distant from the sympathetic network, itself. When the sympathetic is set into action, the following effects are noted: (1) acceleration of the heart, (2) constriction of most of the blood-vessels of the body, (3) secretion of perspiration, (4) erection of the hairs, or the production of goose-flesh, (5) dilatation of the pupil, (6) inhibition of movements of the stomach and small intestines, (7) cessation of gastric and intestinal secretion, (8) transfer of blood from the digestive system to the skeletal muscles, and (9) finally, secretion into the blood stream of a substance known as adrenin.

Adrenin is given off from some small glands located in the vicinity of the kidneys and called the adrenal glands for this reason. It has a number of very specific effects upon the condition of the organism. In the first place, it sets free the supply of sugar in the liver, increasing the concentration of sugar in the blood and may cause a so-called condition of *glycosuria,* or sugar in the urine. It is also instrumental in assisting the redistribution of blood so as to favor the muscles. It increases the tension of the blood-vessels and thus raises the blood pressure. Thirdly, it augments the speed of coagulation of the blood and, finally, it abolishes muscular fatigue with most astonishing rapidity. It will be noted that some of the effects of adrenin are closely similar to those which are produced directly by the innervation of the sympathetic nerves; so that a double mechanism is operative to make certain the establishment of these changes or conditions.

It will readily be perceived that all of these changes are adapted to increase the chances of survival of the animal in a life and death struggle, such as may ensue from an encounter with some other animal of hostile disposition. The inhibition of the alimentary processes makes it possible to withdraw the blood, and to concentrate it in the muscles where it supplies oxygen and fuel to support the needed intensive muscular activity. The increase in heart-action and vasomotor tension, together with the extra outflow of sugar from the liver, contribute to the same end. The counteracting of muscular fatigue obviously increases the efficiency of the motor apparatus, while the greater coagulability of the blood makes for a rapid closure of any wounds which may be suffered. The erection of the hairs increases the apparent size of the animal and may serve to frighten the enemy, and the process of perspiration helps to keep the body cool in spite of the unusual muscular efforts and the consequent generation of internal heat. All of these effects, taken together, may be said to constitute a reaction of *organic preparedness.*

76. *The Stimuli to the Sympathetic Reactions*

We may now inquire into the nature of the stimuli—or in-coming nerve currents—which set off these sympathetic system reactions. A study of the adult animal indicates that there are several classes of such stimuli. Prominent among them, however, is anything which strongly arouses the so-called *pain nerves,* which are the most powerful of the nociceptors. It has been definitely established that the lines of pain conduction from the skin and other points are collected together within the spinal cord into a segregated bundle or cable, and terminate at a definite "pain center" in the thalamus. This is anatomically close to the control center of the sympathetic network, so that any powerful excitation of the pain center might be expected to set off the sympathetic "ganglion" even if there were no specific interconnections between them. However, we may feel entirely justified in believing that such special interconnections do in fact exist. Consequently, we may speak of a *pain-sympathetic reflex* mechanism, through the operation of which excitations applied to the pain nerve-ends can set off the entire complex of effects which are produced by the innervation of the sympathetic apparatus. This is an inborn scheme having an obvious biological foundation, since pain excitations are the normal consequences of actual or incipient damage to the organism, and demand urgent defensive reactions. The sympathetic apparatus also responds to stimuli provided by cold, asphyxia and hypoglycemia.

Now, Cannon finds that in addition to the stimuli above mentioned there are two other specific conditions for sympathetic system response. These are the so-called "emotions" of *fear* and *rage.* The characterization of these emotions in terms of stimuli, or of afferent nerve currents appears to offer some difficulty. In fact, the emotions are most clearly characterized by their efferent, or motor "expressions." These expressions, insofar as they are apparent, are in addition to the preparedness reaction of the sympathetic system, and consist in special movements, or postures of the skeletal system of muscles. In fear, there may be a general innervation of the flexors, a withdrawal of the body or its members from some object or stimulus, running, creeping or other movements leading to flight, crying, etc. In anger, there may be exposure of the teeth, biting, striking out or clawing, and the like. If we are to understand fear and anger as forms of response, we must determine their own stimuli or afferent foundations. However, Cannon's studies have shown clearly that when these motor phenomena of fear or rage are in evidence there is a simultaneous innervation of the sympathetic apparatus, so that we may class the three types of reactions as being conjugate, or correlated somewhat after the fashion of the several groups of ocular reactions which we have already discussed above.

77. *Mechanisms of Anger and Fear*

Suppose, however, that we consider the fear and rage reactions as separate mechanisms apart from the sympathetic apparatus. We must then inquire concerning the adjustor processes (nerve centers) and afferent paths which control these respective forms of muscular activity. In the case of the reactions of rage, Cannon and his school [119] have already established a subcortical adjustor center, which is located in the so-called hypothalamic region. They have shown that these muscular expressions occur in typical form in an animal which has been deprived of its cerebrum, provided that the thalamic centers have been left intact. In fact, such an animal appears to be almost exclusively a creature of rage, manifesting the movements of clawing, biting, striking, etc., continuously without evident stimuli. These movements are, however, quite unsystematized and lack the effectiveness which they possess when the cortical connections are not broken. It would, therefore, appear that there are definite motor incitation mechanisms and processes for anger reactions in the thalamic section of the brain, these mechanisms normally being under the control of the cortex. Their action is such as to energize the skeletal muscles in the movements of attack upon a real or supposed enemy.

The afferent nerve impulses which naturally set off this mechanism have not been determined in the experiments of Cannon, but if we study the reactions of normal animals and human infants, we find that anger is aroused by two different kinds of environmental agencies: first, pain stimulation and, second, holding the animal or the child so that it is unable to move "as it desires." It seems legitimate to suppose that the external confinement or coercion of the animal's muscular system also results in pain excitation, not only of the nerve-endings of the skin, but of those of the motor apparatus (pain endings in the muscles, tendons, or joints). Hence, we may tentatively regard the afferent foundations of the anger response as being substantially identical with those of the sympathetic reactions; although it is probable that in the latter case, peripheral pain plays the greater part, whereas in the former, the pains of the motor system exercise the predominant influence. Anger is far more useful than fear when the animal or man is confined in the clutches of an enemy. There seems to be sufficient reason for believing that the rage response is based upon an innate reflex mechanism, although, like other arrangements of this sort, it is subject to influences from the cortical centers, which may depend upon "experience."

In the case of the fear reaction, we have no physiological evidence to indicate the existence or the location of a subcortical adjustor mechanism. Animals deprived of the cortex do not exhibit typical fear reactions, although they frequently respond with movements of withdrawal or defense, which appear to be of a simpler reflex nature than those of fear. These simpler defense movements are set off by nociceptive excitation. Consequently, we must contemplate the possibility that fear is a less definitely innate motor tendency than is anger. Nevertheless, we can feel quite sure that the fear reaction, whether innate or acquired, will be set off by pain or other nociceptive, afferent processes, so that we should expect it to be associated with the effects which characterize the sympathetic innervations.

It will be noted that we have not considered the idea that fear and anger are psychical states or processes which may play the rôle of stimuli to the activities of lower nerve centers, such as that of the sympathetic system disturbances.

We are, of course, enjoined from any such view by our previously expressed intention to develop a purely physiological account. However, this intention would not prevent us from representing the psychical conditions in terms of processes going on in the cerebrum, which might very well set off the lower center energies. But such cerebral processes would, presumably, not belong in the class of innate reflex dynamisms such as those which we wish to study in the present chapter.

In this connection we may advert once more to the theory of Kempf,[120] who regards the autonomic system as the physiological basis of the emotional or affective life, and views it as the dictator of the cerebrospinal activities. Disregarding the psychophysical difficulties of this theory, we may still criticize it unfavorably on the grounds of physiological fact, since the autonomic system is an essentially efferent apparatus, the operations of which are governed by cerebrospinal centers. Because of the intimate association of the autonomic with a number of very vital functions, Kempf seizes upon it as an exclusive symbol for these functions; whereas as a matter of fact, of course, the entire nervous system is subservient to these and other essential organic processes. The autonomic system, as an individualized section of the nervous mechanism, is a slave and not a master.

78. *Other Complex Reflexes*

It is evident that such responses as those of the sympathetic system to pain stimulation, or of the rage incitors to proprioceptive discomfort, are very complex, so that we might hesitate to class them as reflex in nature. However, we should bear in mind that some of the seemingly most primitive reflexes are also very complicated in their efferent mechanisms. As we have seen, breathing, sneezing, coughing, defecation, etc., require the simultaneous or successive coördinated innervation of a multitude of different muscular systems and, consequently, mere complexity of motor machinery is not a sufficient basis for refusing to classify the process as reflex. In this connection, we may well wonder whether further characteristic innervations of the skeletal musculature will not eventually be demonstrated to have subcortical control centers, and to be capable of occurring in the absence of cortical conduction. Consider, for example, the movements of the skeletal system which are involved in the normal sexual act. The impulse to these movements because of stimulation of the sex organs is very strong. The movements excited by tickling may also belong in this class. In particular species of lower animals, a multitude of such non-cerebral and innate incito-motor mechanisms must almost certainly exist. This leads us very close to the problem of instincts, which we shall consider in the next chapter.

Chapter VIII

The Nature and Existence of Instincts

In our historical review, we have already presented a number of more or less conflicting opinions regarding instincts. It is now our purpose to discuss these and other views from a more critical standpoint. This discussion will necessarily involve two distinct steps. The first concerns the definition or meaning of the word, instinct, because unfortunately this term has been used with many different denotations, some of which are mutually inconsistent while others do not serve to distinguish an instinct from a reflex or, on the other hand, a habit. The second step will be to utilize our final conception of instinct in an attempt to determine whether or not such instinctive responses actually occur in human beings, as well as in lower animals.

79. *Instincts as Complex Reflexes*

The general notion of an instinct is of course fairly well established. It is agreed that instincts are essentially hereditary in their foundations, thus resembling reflexes. Like reflexes, they subserve some definite biological needs, such as those of nutrition or of reproduction. Thus, we speak of the food instinct, the sex instinct, etc. Furthermore, it seems to be the general opinion that instincts are quite complex in structure and function, considerably more intricate in fact than any single reflex. It is true that some writers, such as James and McDougall, include simple reflexes and "reaction units" in their lists of instincts, but this is essentially a secondary thought, arising from a desire for completeness, rather than an indication that they do not regard instincts as being different from these more primitive innate processes. Still, in spite of these tendencies towards agreement, when we endeavor to formulate a strict definition of instinct, we find that authorities do not concur in any very helpful manner.

The very simplest conception of an instinct would be one which identifies the notion with that of reflex action, but which recognizes at the same time that reflex mechanisms vary in complexity. A reflex might be defined as any inherited response which involves a specific relationship between a motor reaction and a stimulus. It might be assumed that there is no critical point of qualitative change in the increasing scale of complexity from the simplest to the most intricate responses of this character. Thus, we might regard the mechanism of breathing as constituting a respiratory instinct, the movements of the stomach as comprising a gastric digestive instinct, etc. A highly complex form of specific response, such as the reaction of the sympathetic nervous mechanism to pain stimulation, could be viewed as a preparedness instinct, differing only quantitatively from simpler innately determined forms of behavior. Even more intricate hereditary response mechanisms may conceivably be demonstrated, particularly among certain lower animal species, such as insects. If we are interested in specific examples of such behavior, we may consult the work of Fabre.

This notion of instinct, as being substantially nothing but a complicated form of reflex action, is, perhaps, represented in the clearest form by the teachings of Loeb.[121] Loeb maintained that so-called instinctive behavior can very likely be explained in terms of his doctrine of tropisms, combined with an understanding of how tropisms are affected by the chemical condition of the body. He found that certain chemical substances, including hormones generated naturally in the body itself, are capable of modifying tropisms in a very radical manner, so that, for example, a tendency to seek the light may be replaced by the opposite kind of movement. It has been shown that in certain animals, the internal secretions of the essential reproductive organs (gonads) are underlying conditions for normal sexual behavior. If the female gonads are transplanted to the castrated male, the latter will show the female form of behavior. Sexual intercourse was explained by Loeb as a form of contact-, or stereo-tropism. Chemotropisms, or directional movements of an animal with respect to olfactory effluvia, also play an important part in sexual response in the lower animals. Chemotropisms are of obvious importance in food-seeking movements.

80. *Instincts as Groups of Reflexes*

Another possible interpretation of instincts in terms of reflexes consists in applying the term, instinct, to a *group* of reflex processes, or mechanisms, all of which subserve the same biological function. For example, we might combine the reflexes of breathing, coughing, sneezing and possibly the control of the cardiac and vasomotor actions, to form a general respiratory instinct, since all of these processes coöperate to maintain the supply of oxygen to the body tissues (together with the elimination of carbon dioxide). Similarly, the reflexes of erection, the movements of copulation, ejaculation, detumescence, etc., might be said to constitute the sex or reproductive instinct. Again, the complex series of responses which are required for nutrition might all be grouped together under the caption of an "assimilative instinct." A study of these several groups of reflexes shows that there is some degree of continuity between them, which might justify us in regarding the grouping as not being entirely arbitrary. Thus, in the case of the processes which are involved in nutrition, taste stimulation sets off salivation, which facilitates swallowing; while swallowing provides the stomach with stimuli to its processes, and these, in turn, serve to regulate succeeding activities in the intestinal section. These relationships harmonize with the notion of a *chain* of reflexes, each one of which provides the stimulus for its successor. The definition of an instinct in terms of a chain-reflex pattern has been advocated definitely by Loeb and other mechanists.

It is, however, easy to attack this interpretation of the term, instinct, insofar as it is supposed to rest upon a demonstrable continuity between the various reflexes which subserve any particular function. These reflexes can readily be regrouped to correspond with some other interests. Thus, we may group the gastric and intestinal reflexes with those of the sympathetic nervous system, when we are considering the pain, anger or fear responses. The neurological continuity between the sympathetic processes and those of the digestive tract is, perhaps, greater than that between the various members of the latter group. A number of writers have attacked the concept of an instinct on the ground that the majority of so-called instincts are really arbitrary groupings of responses in the interests of some particular principle with which a given thinker may happen to be concerned. Thus, if our topic is religion, we carefully pick out all of the neuromuscular processes which are contributory to religious behavior, and segregate these logically under the caption of the "religious instinct." Dunlap [122] suggests that if we are to indulge in such classificatory definitions, we should at least employ strictly psychological criteria; but it is almost certain that the groupings which would be established on such a basis would differ from those having a biological foundation. The great flexibility which appears to exist in the catalogue of instincts as offered by various authorities indicates the truth of the criticism above considered.

81. *Variability in Reflexes and Instincts*

If we regard instincts as being of the same nature as reflexes, we may feel that they should exhibit rigidly mechanical properties. We may be led to lay down the requirement that any instinct must operate perfectly the very first time that it ever comes into use. We are also led to expect that when the proper stimulus is present the instinct must always appear; and that if it involves a series of reactions, these must follow one another in an inevitable order. Attackers of the chain-reflex definition of instinct

—such as Professor Hocking[123]—employ principles of this sort to demonstrate its inapplicability to human and animal conduct. Defenders of the view, however—such as Watson—point out that such rigid determination by environmental conditions is not to be expected, because the internal mechanism of the reflex is not itself rigid, like that, for example, of a metallic machine. Although no one can deny the validity of Loeb's principle that, given the same organic condition and the same stimulus, the same reaction must follow, nevertheless, the organic condition and, in all probability also, the stimulus, are never accurately reduplicated. Following their usual tendency, the opponents of physical explanations show a failure to appreciate the actual properties of physical systems, particularly those which are necessarily involved in all organic functions.

Even if we adopt the reflex conception of instinct, we are certainly not forced to accept rigidly deterministic corollaries. The determinateness may well be a matter of degree. Some reflex arrangements and so-called instincts operate just as effectively the first time they are set off as they do at any later time. Indeed, certain of these reactions occur only once; as is the case of the chipping movements by means of which the little bird escapes from the egg. In other cases, however, movements which have a definitely innate basis are greatly improved by repetition. For example, the food-taking reactions of small birds. This improvement of instincts or reflexes with practice can readily be explained in accordance with the natural assumption that the nerve pathways which are laid down by heredity are nevertheless subject to an increase in conducting power as a consequence of use. It may even be supposed legitimately that some degree of preliminary discharge through a reflex pathway is necessary to bring the entire hereditary mechanism into operation. Thus, we might not only expect an increase in the speed or intensity of an instinct or reflex as a consequence of practice, but also a functional perfection of the device without any real factor of learning being involved. It is, of course, true that this introduces a nonhereditary factor into the final instinctive responses, but this factor does not affect their specificity in any fundamental manner. The action is analogous to that of "breaking in" a machine, such as an automobile.

On the other hand, the notion that an instinct is a complex reflex, or group of reflexes does not actually prevent us from believing in the essential modifiability of an instinct as a consequence of incidents peculiar to the life-history of a given individual. We have seen that the process known as "conditioning" can subject reflexes to the control of new stimuli. Since these may be of any sort whatsoever, varying possibly by continuous gradations from the congenital stimulus, the afferent specificity of the reflex or instinct can manifest a complete flexibility with reference to the modifying action of "experience." Modifications of the efferent portions of the mechanism may be more difficult to establish, but our present knowledge of reflex process does not prohibit such a possibility. It is likely that most of these modifications will be engineered through the cerebral cortex, which can inhibit and distort the motor expressions of a reflex stimulus, when occasion demands. However, it is entirely reasonable to suppose that some changes of this kind may be carried out in the absence of cortical interference.

The inviolability of the reflex order of events is also a predominantly academic notion. Since any reflex process is extremely sensitive to concurrent nervous activity, the exact sequence which it manifests is likely to be disturbed by influences which may not be under the observation of the experimenter. The mere repetition of a reflex or instinctive process may involve an alteration in its relationships to other processes, and if it happens to be *inhibited* at some particular time, its tendency to recur may be permanently depressed. In a nutshell, the definition of instincts in terms of reflexes renders the former subject to all of the principles which Sherrington and others have demonstrated to be applicable to reflex processes. These are by no means such as to demand an absolute invariability.

The question as to the determinateness of a reflex or instinct has an interesting aspect which appears in Kuo's attack upon the general doctrine of instincts. Although Kuo denies the existence of instincts, even in animals, he does admit that there are innate motor mechanisms ("units of reaction"), and that these are aroused with some degree of selection by different stimuli. Thus, although—according to Kuo—the sight of an enemy does not liberate a specific set of reactions constituting a flight instinct, nevertheless it may arouse a reasonably restricted group of random movements, which may later be narrowed down as a consequence of "experience" to yield the most beneficial form of response in the given situation. Since all stimuli do not, however, arouse all possible random movements, but make a rough selection among them, we have to admit the existence of a certain degree of specificity in the hereditary connections. The factor of learning is evidently required here to complete the response system, but this does not enable Kuo to dispense with the assumption of some degree of "instinct."

82. *The Teleological Conception of Instinct: Physiological*

The notion of an instinct as an essentially reflex device is contrasted by E. C. Tolman [124] with what he calls the *teleological* conception. According to this idea, an instinct is to be characterized not by a fixed relationship between stimulus and reaction, but rather by an "end," which is to be achieved. Such "ends" are not necessarily represented directly in the instinctive action or mechanism, but merely serve to satisfy or to terminate the action when they are "realized." The "ends" may consist in particular relations between the organism and factors in its environment, or in certain organic conditions which result from a change in the relationship of the organism to its environment. Thus, in the case of the instinct of flight, the organism "escapes," or places itself in an environment lacking an enemy. In the food-seeking instinct, food is brought into the mouth and swallowed, and the cessation of the instinctive activity follows from the consequent change in the gastric processes.

The teleological conceptions of instinct are characterized by a high degree of indeterminateness in the specificity of the instinctive responses. However, the instinct mechanism is by no means wholly indeterminate. Definite stimuli arouse the instincts, and they are set at rest once more by the incidence of further specific stimuli or organic conditions. The thing which is "aroused" in this process seems to be a central nervous activity of a somewhat general kind rather than a particular adjustor and efferent mechanism, as in the case of a reflex. Perhaps the clearest picture of this sort of instinctive process is that offered by Craig [125] in his doctrine of appetites and aversions, which we have already considered in some detail. All of the teleological doctrines involve the notion of "random movement," struggle, unrest, or "trial and error" reaction, which furnish the basis for a successful resolution of the instinctive disturbance.

These teleological theories may be divided into three sub-classes (following Tolman): (1) the physiological, (2) the behavioristic, and (3) the psychological.

The physiological interpretation appears not to have been given any very clear expression by contemporary writers, although the views of Dunlap and of Craig suggest it strongly. It may be outlined somewhat as follows. An organic condition develops which has the nature of a need or want, and which acts as a nervous excitant, usually through the medium of certain sensory channels. As examples of such conditions, we may cite the following: (1) lack of food in the stomach, with accompanying changes in the gastric secretion and movements, (2) damage to the skin or other organs, (3) obstruction of the breathing movements, (4) dryness of the walls of the mouth cavity, owing to lack of the proper amount of moisture in the body, (5) tumescence of the sex organs, (6) excessive pressure of the bladder contents, (7) loading of the large intestine with fecal matter, etc. Each one of these organic conditions is capable of exciting a definite afferent nerve channel, and we may suppose that in the case of instinctive response the effect is not strictly reflex (although there may be accompanying reflexes), but the generation, instead, of a varied series of incito-motor process which result in so-called random movements. The exact character or range of these movements may be limited, as suggested by Kuo, by the identity of the afferent channel which is responsible for the activity. Eventually, a movement or a series of movements may occur which will result in an alleviation of the initial physiological condition, and this will naturally bring the discharge of the varied motor innervations to a close.

It is obvious that the definition of instincts in this manner leaves them open to radical modification during the life-history of the individual. In fact, instincts as thus defined provide the raw materials for the processes of learning. As suggested in our discussion of the learning process in lower animals, the particular form of random behavior which is successful in removing the disturbing physiological condition tends to be "stamped in," and at a later time to follow immediately or with a reduced amount of experimentation, when the same organic state recurs (assuming, of course, a similar environment). The principle of the conditioned reflex will also apply, so that stimuli which have been associated with a given exciting condition may later arouse the central unrest processes in the absence of the condition in question. In certain cases, such as erotic tumescence, these secondary stimuli may set off lines of nervous conduction which bring about a reproduction of the primary physiological state. The final effect of "experience" upon such an instinctive mechanism may consist in a direct, learned, reaction to a stimulus the effectiveness of which has also been established by learning. As an example, we may consider the act of kissing a sexual mate, in which the selection of the particular individual to be kissed, and the kissing reaction itself are not predetermined congenitally, but are nevertheless based upon an association with the sex "instinct."

If we make up a list of fundamental instincts on the basis thus suggested it would run somewhat as follows: (1) hunger, (2) desires for relief from pain, heat or cold, (3) desire for air, (4) thirst, (5) lust, (6) desire to micturate, (7) desire to defecate, (8) desire for a change. In the case of the female, under appropriate conditions, we might add, (9) the desire to lactate. The use of the word, "desire," in this connection is not to be interpreted psychologically, but merely in terms of the physiological mechanism which has been outlined above. Some of these so-called desires coincide with items in Dunlap's list (q. v.), but the majority of his "fundamental desires" appear to be of a derived type, involving "experience" as to what is needed in society, or the world at large, to bring about satisfaction. It seems entirely improbable that there are any innate desires of "shelter, conformity, preëminence, or progeny."

We may note again that the satisfaction of almost any fundamental desire involves the execution of a so-called "consummatory reflex," which is instrumental in bringing about the cessation of the physiological disturbance. However, it seems doubtful whether such reflexes form an essential part of the desire mechanism, as viewed from the neurological standpoint. The disappearance of hunger, for example, does not follow immediately as a consequence of "swallowing," but through the action of food upon the stomach lining. The hunger disappears just as soon if feeding occurs through a gastric fistula. Similarly, if the bladder could be emptied through an incision rather than through the urethra, the release from the desire to micturate would probably be just as complete in the former as in the latter case. Sexual desire, however, might not be gratified by an artificial emptying of the seminal vesicles since the physiological state here is probably one of nervous rather than vesicular tension.

A correlated aspect of the situation lies in the fact that the physiological state, *per se,* is not an essential portion of the desire or instinct, which depends, rather, upon the afferent nerve impulses which are normally set off by this state. If these same afferent impulses are aroused artificially—perhaps only through conditioning or association—the desire will be just as strong as if the physiological state were actually present. Accordingly, we may suppose that the satisfaction of the desire consists essentially in a cancellation of these particular afferent excitations. This normally occurs when the given physiological state is removed, but might also be brought about, say, by paralysis or inhibition of the afferent nerves. The essence of the "instinct" would therefore appear to be primarily in the afferent nerve impulses and the processes which they set off in the nerve centers.

83. *The Teleological Conception of Instinct: Psychological*

A *behavioristic* definition of instinct along teleological lines would differ from the above in that it would not attempt to specify the internal mechanism of the process. Thus, Tolman [126] defines an instinct as a "determining adjustment" which is set off by particular stimuli, either external or internal, and is followed by "neutralizing adjustments," which are also due to other specific stimuli. The relationship between these stimuli and their respective adjustments is innately determined. These adjustments are "to be recognized and defined primarily by the type of *external* behavior 'organism-object' rearrangement they bring about. Thus 'flight' means always 'getting away from'; hunger, always a 'searching and eating of'; sex, always a 'searching and excitement of the sexual organs from'; curiosity, always a 'searching and manipulating of' "; and so on. In other words, the determining adjustments (or instincts) are recognized by the teleological patterns of the final goals which they achieve." A definition of this purely behavioristic type may have an advantage over the physiological statement in that it involves less hypothesis, but it has the evident disadvantage of being difficult to understand, and of eventually requiring the physiological details to make it complete.

The *psychological* conception of an instinct has been developed with great elaboration by McDougall. It would seem difficult to adhere strictly to the physiological plane of thought and yet to utilize such a psychological definition. If we follow McDougall's plan, however, we can define an instinct as an anatomical or physiological entity which is *correlated with* certain psychological phenomena, without actually implying that these latter phenomena play a part in the physiological processes. We have already seen that McDougall's scheme correlates a specific instinct with each separable emotion, emotions being regarded as essentially psychical processes. Such a manner of definition might well lead us to an attempt to identify and examine the physiological factors which are thus indicated, after which we could dispense with the reference to the emotions. This is said, however, without any intention of denying the interest which attaches to the psychophysical correlation which is here involved. Tolman argues that it is illegitimate to define instincts in this manner, since the emotions can only be identified, or proven to exist, by observing behavior. But this objection seems to be based upon the usual fallacy of behaviorism, in which the behaviorist fails to take cognizance of his own consciousness.

McDougall's later writings [127] seem to treat instincts not as ordinary physiological affairs, but as semi-transcendental "hormic" forces which are more mental than physical in character. These forces operate consciously, or unconsciously in a crudely directional manner so as to attain certain ends, which they recognize when achieved. The behavior of the individual is an expression, on the objective side, of the appetitional energies of these hormes, whereas the emotion as a phenomenon in consciousness reflects the same activities on the subjective side. It is to be feared that McDougall's general conception of an instinct is too vague to be of much logical value, although his applications of the concepts of specific instincts are most interesting. The vagueness of the psychological ideas is exemplified in Drever's [128] definition of an instinct as the "life impulse becoming conscious as determinate conscious impulse" . . . "the impulse becomes a particular conscious impulse with regard to a perceived object or situation." However, it is not possible to agree entirely with those critics who would throw out the notion of instinct just because we may be unable to formulate any detailed account of its nature. There is certainly some significance in the statement that the mind or the organism is endowed by heredity with a group of specific entities which operate to influence its consciousness or behavior in certain general, but, nevertheless, specific ways. But, we cannot be satisfied with such a definition, because we shall remain curious concerning the exact nature of these entities, and how they work.

In an endeavor to settle upon a satisfactory definition of instinct, it would seem advisable to adopt one which actually differentiates between instinctive and purely reflex action. At the same time, the definition must be as "clear and distinct" as is possible. If we apply these criteria, it seems that the physiological form of the so-called teleological conception is the only one among the conceptions presented above which can be accepted. The type of innate mechanism which is contemplated in this view is surely sufficiently dissimilar to that of the ordinary reflex to deserve a special name. At the same time, the process is specifiable in considerable detail, in fact, in rather too much detail to permit of a "snappy" formulation such as we like to have when we are laying down a definition.

84. *Image-Instincts?*

However, there is another possible way of distinguishing between instincts and reflexes, which does not appear to have attracted very much attention; although it is latent in McDougall's writings. This lies in the idea that the increased complexity of the mechanism of instinct as compared with that of a reflex, lies on the afferent rather than upon the efferent side of the response arc. In attempting to arrive at a satisfactory conception of instinct, we are governed to a large extent by a desire to interpret the forms of behavior which are ordinarily described as instinctive. Now, in the majority of cases, we find that the stimuli to such so-called instinctive action are conceived to be more complex than those which set off simple reflexes. Reflex response can almost always be released by certain physical forces or energies of a general type, such as pressure, heat, or chemical substances, applied to some rather extensive area of the bodily sensory surfaces. The exact *form or configuration* of the stimulus over the surface in question is without any very important bearing upon the nature of the resulting reactions. Instinctive response, on the other hand, appears to share with voluntary behavior a determination by the exact pattern of afferent excitation, slight changes in this pattern with no accompanying alteration in the general form of energy which is involved, frequently bringing about a complete modification of the reaction. Thus, we run away from a bear and embrace a friend, although in both cases the stimulus is optical and may be of about the same average intensity. The reflexes of the pupil do not differentiate at all between these different optical patterns.

Following this cue, we might define an instinct as *an hereditary specific response which is determinate with respect to the configuration of the stimulus energy over the particular receptive area which is concerned.* Almost any kind of a specific response which is based upon ordinarily significant differences between visual stimuli would fall into this category, if it were considered to be hereditary in its foundations. A very important example would be demonstrated if it could be definitely shown that the male has an hereditary preference for the appearance of the female, as compared with that of his own sex; or even if he has an hereditary predisposition to seek the female genitalia as preferable means of exciting the consummatory sexual reflexes. On the other hand, the operation of these reflexes themselves as a consequence of friction of the sexual parts would not be instinctive. From the psychological side, an instinct thus defined would involve *ideas or perceptions*, whereas reflexes would be sufficiently determined by "simple sensation."

Now, it seems highly probable that the sensory pattern factor in so-called instinctive behavior is not innate but is acquired; it is something which is added to the hereditarily founded mechanism by "experience." However, this is a question which requires examination in the light of facts, and our ordinary impressions certainly lead us to believe that hereditary sense-pattern responses actually do exist. Practically any specific reaction to an "object" or "situation," rather than to a general condition must fall into this class. If we wish to retain the term, instinct, to describe some actual mechanism, and not merely something which is entirely hypothetical, we may do well to reserve our decision as to the definition of "instinct" until we have examined some of the facts bearing upon the problem.

85. *Two Alternative Conceptions of Instinct*

In the meantime, let us define two different forms of instinct. The first will correspond to the "physiological teleological" notion and may be known as *appetitional instinct*. Its nature may be formulated as follows: *An appetitional instinct is an inherited neural mechanism, aroused primarily by the general excitation of a specific sense channel, and leading to relatively random motor innervations, among which it is probable that one will eventually appear to bring about organic changes reducing the intensity of the originally given afferent excitation.* The other species of instinct may be designated an *image-instinct*, to indicate its dependency upon the exact pattern of stimulation. Its formal definition has been given above.

We may now consider whether or not either of these types of instinct are manifested in human beings, or in lower animals, and, if so, what the principal specific instincts probably are. The answers may very well be different for man and the other animal species. If we may anticipate our conclusions, we may say that image-instincts probably exist in some lower animals, although they are much rarer than is commonly supposed. Their existence in the case of the human being is extremely doubtful. Appetitional instincts, however, undoubtedly exist in all animal species, being particularly important in the human. Accordingly, for the human being, the definition of instincts in appetitional terms is the only one which is of importance.

Although the concept of image-instincts has not been definitely formulated heretofore—so far as the present writer is aware—nevertheless, numerous investigations and arguments have been recorded which bear directly upon the question which it raises. The principles of the conditioned reflex and of learning in general, obviously tempt one to reduce the hereditary tendencies to the simplest and crudest possible form, which makes them depend upon "sensory" rather than upon "perceptual" factors. Thus, it has been shown that young chicks pay no attention to the visual differences between various objects in regard to their food value, but peck at them indiscriminately, until "experience" has shown them what is good and what is bad. The human infant does not seek its mother's breast, and only sucks when something is placed in contact with the lips; and it makes very little difference in the beginning what this something is. Babies do not fear any particular objects, until they have associated these with pain or loud sounds. Neither are they aroused to anger by objects, but only by proprioceptive discomfort. Watson's studies of the responses of very young babies fail to reveal any case of image or pattern-determined response. The most difficult case in this regard, in human beings, is undoubtedly that of heterosexual preference, or the tendency of the male to seek the female and *vice versa,* for satisfaction of the erotic appetite. We shall discuss this in detail later.

However, when we study the behavior of lower animals, the absence of innate image-determined responses is by no means so clear. Even the chick, when he pecks at any object at all, is reacting to a fairly definite pattern. Kittens seem to have a definite fear reaction to any large, furry, object. They will "spit," arch the back and raise the hair, when they see a fur rug, a person dressed in a fur coat, a dog, or another (strange) cat. The diversity of these objects rather precludes the theory that the actual stimulus is olfactory. The writer has seen a young kitten exhibit these reactions when confronted by its own reflection in a mirror, in which case the olfactory stimulus could certainly not have been operative; although it is conceivable that this particular kitten may have had some previous experience with this reaction which had associated it with the visual image of a cat. The behavior of kittens with mice also suggests visually predetermined reactions, although there is a greater possibility of an olfactory basis here. It is quite possible that in some of the lower animals, the cortex is a center for a few innately determined image-reactions, whereas in the human cerebrum all of these congenital patterns have been swept aside to clear the way for learning. One of the most cogent arguments against the existence of image-instincts is the complexity of the germ-plasmic and ontogenetic process which would be required to transmit them. The case is somewhat similar to that against the transmission of acquired characters. The germ-plasm is already sufficiently overloaded with duties without subjecting it to any further obligations, which may be based upon undemonstrated requirements.

The appetitional instincts in human beings appear to correspond closely with the outline which we have already presented above. These instincts must be regarded as depending for their arousal upon the specific energy rather than the exact pattern of their characteristic stimuli, although it is logically conceivable that we should find image-appetitional-instincts. Response systems of the image-appetitional type are certainly developed by "experience." In making a list of the appetitional instincts, we should be guided by biological rather than by psychological or sociological considerations. It is possible that we may find tendencies in gregarious animals which are the outcome of social evolution, as applied to the individual; but it is doubtful whether man is a very highly socialized animal genetically. Bees and ants are undoubtedly far more likely to have social instincts than is the human being. The transmission of social tendencies in human beings is, perhaps, for the most part a matter of culture. The anthropoid ancestors of man are individualistic rather than gregarious, and anthropology suggests that the compact social systems of present-day humanity are the creation of the last ten thousand years, which is such a short period that it can hardly be expected to have any very important representation in human hereditary endowment.

Chapter IX

The Catalogue of Human Appetitional Instincts

We may now proceed to consider in some detail the list of human instincts or innate appetitions. Each of these inborn mechanisms conforms to our definition by including: firstly, a particular afferent nerve process which is normally generated by a special physiological condition. This condition may be of any conceivable sort, mechanical, chemical, or even exclusively nervous in character. As a rule, it will correspond to a biologically important *need*. Secondly, the given afferent nerve currents must arouse a central mechanism of random or semi-random motor-incitation. This mechanism will presumably be located in the cerebral cortex and may be essentially the same for different fundamental instincts, although we may find that the series of movements which it sets off are determined to some extent by the nature of the afferent excitation. Finally, it must be possible for these movements to discover a new stimulus which can act so as to remove or to inhibit the original afferent excitation. This effect may be due directly to the setting off of a "consummatory reflex," or, on the other hand, it may be a secondary consequence of the operations which are performed by such a reflex.

We may begin our special studies by considering the so-called nutritional, or food-seeking instinct. The biological function of this arrangement is, of course, the provisioning of the body with protein and carbohydrate material, together with other solid substances which are needed to maintain its structure and metabolism. However, the quest for food is not innately determined by a desire to accomplish these ends as such, but is directed instead toward relief from a form of afferent nerve excitation which appears when the organism has been deprived for some time of food. The mechanism may be described as follows.

86. *The Mechanism of Hunger*

The investigations of Cannon have proven definitely that the afferent excitations of hunger arise in the walls of the stomach. The condition of the stomach walls depends upon the history of this organ with respect to the presence or absence of food. When food is present, the stomach walls actively secrete digestive fluids, ferments and hydrochloric acid, but after the stomach has been empty for some time, a condition develops which manifests itself in rhythmic contractions of the organ. The incidence of these contractions may depend, in part, upon the chemical condition of the blood which is circulating through the stomach walls, or upon central nervous influences in certain cases. At any rate, after five or six hours' absence of food, the contractions give rise to specific afferent nerve currents which are transmitted to the higher centers, including the cerebral cortex, via the vagus nerve. Here they correspond with the so-called "pangs of hunger" which appear in consciousness. Their exact origin in the stomach walls is to be sought in certain receptor cells which are stimulated by the gastric movements, when the chemical state of their environment is appropriate, but when the stomach has recently been actively digesting food-contents, these receptors are not sensitive to the pressures which develop from the contractions. Consequently, the movements of the stomach which occur during digestion do not give rise to the afferent nerve impulses which characterize hunger.

If food is not forthcoming, as in the case of a long fast, the gastric excitations gradually weaken so that after a period of two or three days, the nervous processes come to an end, although the physiological need for food increases steadily. Death, as a consequence of starvation, is possible in the entire absence of hunger impulses. These impulses occur at the highest intensity when food is provided in inadequate amount, rather than after a protracted period of complete abstinence. Hence it seems that the essential condition for the stimulation of this sensory mechanism involves a state which is transitional between normal nutrition and starvation, its function being to prevent the incidence of the latter state. In cases of malnutrition, due to disturbances of intestinal digestion or other chemical causes, there may be pathological symptoms similar to those observable during starvation, but with no accompanying hunger. Thus, the hunger process is by no means a perfect defense against starvation, although under normal conditions it achieves a biologically indispensable result.

When the hunger impulses reach the cortex—or, possibly, certain subcortical centers—they set off various innervations of the skeletal musculature. In the "experienced" adult, these movements are such as to bring the organism into the vicinity of food, and to carry the latter into the mouth. However, we must suppose that in the ideally "inexperienced" human infant, the movements in question are essentially random in character. They will probably involve attempts at locomotion; the mouth is likely to be applied to any object which comes into contact with the face; the fingers may be carried to the lips, or—at a later stage of development—objects may be grasped and put into the mouth; crying is almost certain to occur, together with general unrest, thrashing about, wriggling, and so forth. As age increases the individual's repertory of possible movements, other more complicated reactions will be included; and the greater the individual's "experience," the more likely it is that some of these reactions will provide the organism with food. However, even a mature human individual who is placed in absolutely strange circumstances, will react to the hunger excitations with behavior which will be very poorly adapted to bring success. This is frequently the case in our everyday efforts to gain a livelihood, when such efforts are based upon insufficient or incorrect information regarding their probable consequences.

In the case of human infants, there seems, in the beginning, to be some slight tendency for the movements resulting from hunger to have immediate functional value. The sucking reflex cannot be evoked under a condition of gastric satiety, but appears with great avidity during hunger. Lower animals, such as kittens, show a much greater specificity in their movements; one of the first acts of the new-born kitten is that of crawling towards its mother's abdomen, and the application of its mouth to her nipples. This group of movements subsides when an adequate amount of milk has been taken. In the case of kittens, we are probably dealing with definite reflexes, as well as with an instinct. The instinct factor may always be considered to consist in the *proportion of randomness* which the reactions exhibit, which may have to be abstracted from an accompanying degree of specificity.

Suppose that one of the random reactions is successful in bringing food to the mouth. Thereupon, in the infant, the sucking and swallowing reflexes ensue, whereas the adult will masticate the food before swallowing it. The consummatory deglutition reflex does not, in itself, alleviate the hunger impulses; and sucking, mastication and swallowing will continue so long as food remains available and the chemical state and movements of the stomach have undergone no radical changes. Eventually, if sufficient food is ingested, these changes occur so that the hunger impulses subside. We then find that the food-seeking restlessness also disappears, so that the processes of ingestion come to an end. The hunger instinct is thus satisfied.

87. *Complications of Ingestive Appetition*

This provides us with a description of the instinctive thread of the nutritional process, but there are numerous neurological accessories which it may be well to consider here; although some have already been discussed and others will be given a more detailed treatment in later chapters. In the first place, we should realize that the satisfaction of hunger sets off the entire group of alimentary reflexes, with the possible exception of defecation. Consequently, it would not be at all surprising if a number of specific afferent nerve currents, differing from those of hunger, should be set off and reach the cortex after the hunger has disappeared, or in the course of such disappearance. These may correspond to our psychological feelings of alimentary satiety, etc., and may be expected to affect the course of the response. Secondly, the presence of food in the mouth liberates a very complex and specific group of afferent nerve currents through the channels of taste, smell, and touch. These gustatory, olfactory and tactile excitations derived from the membranes of the mouth and nose, play a very important part in the continuation or cessation of the food-taking process.

If the taste receptors for sugars are stimulated, the movements of sucking, masticating and swallowing will be strongly reinforced. On the other hand, if those for alkaloids (bitter things) are excited, the ingestive operations may be inhibited and the contents of the mouth may be forcibly ejected. Olfactory stimulation, either through the anterior or the posterior nares, will have corresponding influences if the substances which are taken into the mouth arouse appropriate types of olfactory afferent nerve currents. Thus, ethereal or fragrant odors, such as those of fruit, will aid the ingestive process, whereas those of putrescent material will inhibit it. In the tactual classification, hard or very hot material taken into the mouth will have an inhibitory effect, while moderate degrees of warmth or coolness, soft contacts, etc., will facilitate the process.

Moreover, if the substances which are actually taken into the stomach prove to be unfit for assimilation, they may arouse the vomiting reflex, which not only inhibits the food-taking activities but gives rise to characteristic afferent impulses which are received by the cortex, and have a profound effect upon general behavior.

If we adhere to our previously established definition of instinct we may not be able to include these reflex and special sensory processes as integral parts of the hunger instinct. Nevertheless, they play a very important rôle in nutritional motivation, and this will need to be considered in detail. The food-seeking reactions of the "experienced" organism probably depend more upon the influence of smell, taste and nausea than they do upon that of hunger. However, this dependency definitely involves a process of learning, and hence cannot be regarded as being characteristically instinctive. This furnishes the foundation of "appetite," which Cannon distinguishes from hunger as being a pleasant, rather than an unpleasant, incitement to eating.

However, we should face the question as to whether the gustatory, olfactory and nauseous nerve currents should not be regarded as providing the bases of appetitions which are similar in their mechanisms to hunger although distinct from the latter. If we examine the forms of behavior which appear when certain of these subsidiary alimentary senses are excited, we are driven to the conclusion that they are to some extent appetitional in our technical sense of the term. This is certainly true of nausea, which results in varied attempts on the part of the animal or human being to rid itself of the given physiological condition with its accompanying afferent nerve currents. However, the reflex of vomiting is much more effective in accomplishing this desideratum than any action of the voluntary muscles can be, and in case the excitation is intense, vomiting follows automatically and, as a rule, removes the cause of the irritation. But in the case of nausea, resulting from so-called mental causes, or from excitation of the equilibrium sense-organs of the inner ear, vomiting may not bring relief, so that the unrest will continue until a condition is found which is really effective in removing the cause of the trouble. This may consist in reclining, or in leaving the ship, in case of sea-sickness; or in departing from some unpleasant surroundings which may have induced an associative nausea.

Similar behavior can be observed in the case of gustatory and olfactory stimulation. A bitter substance in the mouth apparently produces afferent nerve currents that bring about a cortical unrest, which does not cease until the offending material has been removed. Undue stimulation with salty or sour substances can have the same effect. The "unpleasant" odors operate in a similar manner, eventually driving the organism away from the malodorous environment. Excitations of the sensory mechanisms corresponding to "pleasant" odors and sweet tastes do not seem to have the same degree of appetitional effect. In the adult animal they more frequently lead to specific reactions, which seem to have been established by "experience," whereas in the naïve individual, they reinforce whatever is going on at the time.

88. *Thirst*

The instinct or appetition of *thirst* is naturally aroused by an abnormal decrease in the amount of water in the body. This makes itself felt, first, in the membranes of the back of the mouth, from which point it gives rise to afferent nerve impulses that set off seeking movements similar to those observed in hunger. When appropriate liquids are found and swallowed, there is an immediately partial relief from the thirst, as a consequence of the wetting of the mucous membranes of the buccal cavity, although complete cessation of the thirst appetitional impulses does not follow until the aqueous equilibrium of the organism has been reëstablished. It is well known that individuals who have been without water for a long time are in danger of drinking too much when they finally become able to quench their thirst.

The fact that the hunger and thirst mechanisms are seldom intensely aroused under civilized conditions tends to make us fail to appreciate the tremendous power which they possess when food or drink are seriously withheld. Observations upon decerebrate dogs and upon human children who have been born without higher nerve centers indicate that both the hunger and thirst instincts possess important subcortical adjustor mechanisms, which are capable of carrying out instinctive or appetitional processes independently of the cortex. However, in the human being, at any rate, the cortical mechanisms are normally of paramount importance in the regulation of these responses.

89. *Aversion to Pain*

From the psychological standpoint, hunger and thirst may perhaps be regarded as particular forms of *pain* sensation. Pain is the name of a large class of afferent disturbances, rather than of a particular kind. Thus, from a psychological point of view, dental pain is very different from that due to injury to the skin, while internal, organic pains are, again, distinctive in quality. It is quite likely that there are corresponding differences between the afferent nerve mechanisms of pain. However, if we regard the pain processes from an objective or physiological standpoint, they show a general similarity. The pain nerve endings in the skin, and elsewhere, are distinguished by their lack of special receptor cells, and by their relatively high thresholds of excitation. As we have seen, the pain nerves from various parts of the body are collected into a single conducting bundle in the spinal cord, and have a common center in the thalamus.

If we observe the behavior of a man or animal when pain nerves are excited we find ordinarily, first, that the particular activity which is going on at the time is inhibited. The animal then indulges in a series of movements which may finally be successful in eliminating the cause of the pain. In an adult animal, such movements are usually reasonably well adapted to this end, but in the "inexperienced" animal they may be random in character. Consider the classical example of the baby who is being pricked by an open safety pin. The result is not only crying, but general unrest, involving a succession of movements which continue to be unsuccessful in removing the cause of the pain excitation. Similar phenomena are exhibited by an adult individual who is suffering from some non-remediable pain, such as a headache. He is unable to remain quiet; if he is lying in bed because of the indisposition, he tosses and turns, sits up and lies down again, tries various medicines and applications, etc. If, eventually a position of the body is found which relieves the pain, these movements cease and the posture tends to be held. Then, frequently, sleep will ensue and upon waking the organic disturbance may have disappeared.

Along with the appetitional or instinctive process which is set off by pain stimulation, there is a concomitant arousal of reflex expressions. In the lower animals—and, possibly, in some cases in human beings—there is an immediate reflex which is directed towards the removal of the pain-producing stimulus. Consider, for example, the flexion reflex of the decerebrate dog. Painful stimuli which are applied to the limbs of a human being probably set off withdrawing reactions through an entirely reflex mechanism. Also, at the same time in all pain stimulation, there is a general excitation of the sympathetic section of the autonomic nervous system.

90. *Thermal and Respiratory Appetitions*

Another innate appetitional mechanism is based upon the temperature senses or thermal receptors of the skin. The operation of this "thermal instinct" closely resembles that of the "desire to escape from pain," but has certain peculiarities of its own. The afferent systems for "warm" and "cool" are well-known to be related to each other in a balanced manner; they are neurologically opposed or mutually inhibitory. They are also subject to intensive *adaptation,* a process of variation in sensitiveness to temperature levels which tends to reduce their response to any given temperature condition if the latter continues over any considerable period of time. However, when excitation of the receptors for "warmth" exceeds a certain value, the usual "unrest" develops, so that movements ensue which only stop when the excessive skin temperature has been reduced. Similarly, a continued excitation of the receptors for "coolness" results in random movements which persist until the skin temperature is raised. In the case of "coolness" the unrest does not appear immediately if the afferent excitation has been preceded by an unrest state attributable to excessive "warmness." A similar effect is noted in the case of the reaction to "warmness" in relation to previous reactions to "coolness." These interrelations are partly due to changes in the relative sensitivities of the receptors, but probably also involve central adjustments.

The "desire for air" is one which plays a relatively minor part in the normal life of animals, but assumes tremendous importance when conditions are such as to threaten suffocation. If the breathing movements or the nose and mouth passages are obstructed, afferent nerve impulses are set off which seem to originate in the lungs, and bring about struggling or unrest. The most frequent occasion for such a reaction exists when a land animal gets its nose and mouth under water. Similar behavior may, however, be set off under conditions of foul air, chemical gassing, or pathological disturbances of respiratory processes such as occur in pulmonary and cardiac disease.

91. *The Mechanism of Erotic Appetition*

The much-discussed sexual instinct conforms, in general, to our definition of an appetition, but shows some distinctive features, which are related to the fact that on the psychological side the initial sensory disturbance is usually pleasant, rather than unpleasant. Experiments on animals such as the toad and frog have shown that in the case of the male, sexual desire is attributable, at least in part, to the pressure of the seminal fluid against the walls of the vesicles. This, however, is obviously a difficult principle to apply to the case of the female of any species, although here we may have recourse to the ovarian processes, which correspond in periodicity with variations of sexual activity. Nevertheless, neither of these ideas seems to apply very helpfully to the manifestations of the sexual impulse in human beings, where erotic excitability is independent of time, and relatively independent of physiological condition. Erotic desire may persist in men even after repeated gratifications in close succession.

A rather extensive search for special "genital" sense organs or receptors in the erotically sensitive portions of the body has apparently resulted in complete failure. Hence, we are forced to suppose that the appetitional disturbance in the case of sex is essentially a product of a nerve center device. This erotic center is presumably located on the afferent side of the response arc, and is subject to the excitatory influence of more afferent nerve currents, which are derived primarily from the external reproductive organs, especially when the center is in an excited condition. The total absence of evidences of sexual desire in decerebrate animals suggests strongly that this afferent center is located in the cerebral cortex, but other considerations might lead us to identify it with the spinal reflex adjustor for the mechanisms of erection and ejaculation. It is not at all unlikely that more than one level of excitation may be involved in such an important function.

The mechanism of erotic appetition in man, may be sketched somewhat as follows. Assuming, first, a nerve center on the afferent side of the response arc which is capable of cumulative excitation, this center may be supposed to be normally quiescent, but to be played upon by afferent nerve currents from various sources. Some of these may arise in the seminal vesicles or ovaries. However, the most important source lies in mechanical excitation of the sensory end-bulbs of the glans penis, clitoris, walls of the vagina and the muscles which consummate the ejaculatory reflexes. Impulses of moderate intensity from these sources are not sufficient to cause any accumulation of excitation in the erotic center, but when they exceed a certain intensity such an excitation is built up in proportion to the strength of the nerve currents, these being greatly reinforced during the turgescence of the sexual parts which usually accompanies the activity of the erotic center. Thus the activity becomes to some extent circular and self-sustaining. We may, furthermore, suppose that in both sexes—but more particularly in the female—tactile excitation of the nerve endings in the mucous membranes of the lips can contribute to the excitation of the center; and also—in the female—similar stimulation at the nipples. Warm, smooth contacts with other portions of the body may also find the erotic center particularly accessible.

When the center is in a state of excitation, any form of sensory stimulation in the genitalia—with the probable exception of intense pain—contributes especially to its further arousal. The center is accessible to visual, auditory, and other "exteroceptive" nerve currents, but specific relations between these and its activity must be established by "experience." In the case of lower animals, there may undoubtedly be found cases of innately determined excitation of the erotic center by olfactory stimuli, such as are associated with the functions of the opposite sex in the same species. Thus, we find that in the case of the male dog, the odor of the secretion of the glands in the mucous membrane of the vulva of the female increases the erection of the penis, through olfactory channels. The nerve impulses resulting from the excited state of the erotic center may be assumed to be responsible for the voluptuous sensations which appear in consciousness, and which are ordinarily localized in the sex organs.

The initial stages of excitation of the erotic center are accompanied by the reflexes of erection and preliminary secretion in the sex organs, and when the excitation reaches a certain critical value, the consummatory reflexes are set off. Since these two groups of reflexes are known to be controllable through the spinal cord alone, we must either identify the erotic center with the adjustor for these reflexes, or else we must suppose that the spinal center excitation is reinforced by that of the erotic center. If we draw upon introspective observations as evidence, we shall probably decide that the adjustor for the reflexes and the erotic center are distinct, but interconnected, since the intensity of voluptuous sensation has a very variable correlation with the facility with which the reflexes can be released.

The afferent nerve impulses which are transmitted to the incito-motor mechanisms of the cortex, and which constitute here the cause of sexual unrest, must be supposed to arise from the excitation of the (afferent) erotic center. The movements which ensue are essentially random in character, but if they finally evolve a method of raising the excitation of the spinal reflex adjustor to a critical point, the consummatory reactions will occur. We may suppose that the discharge of the nerve currents which control these reactions is followed by a lowering of the tension (refractory phase), at least in the spinal center, with consequent detumescence of the sex organs, thus removing certain stimuli to the erotic center previously provided or intensified by the tumescent condition. The erotic center itself—if it be different from the spinal one—may go over into a condition of relative refractory phase or fatigue as a consequence of the intensive stimulation to which it is subjected during the ejaculatory process; so that the state of tension subsides and the unrest disappears.

The sexual instinct, as thus described, differs from most of the other instincts in that the primary cause of the appetitional excitations is not a general physiological need, of a non-nervous character. The reason for this peculiarity obviously lies in the fact that the need which the sexual reactions subserve, pertains to the race rather than to the individual. No general injury to the individual can follow as a consequence of failure of this instinct to operate, but the injury to the species would be irreparable. Hence it has been necessary for evolution to generate a mechanism in the individual which will minister to the requirements of the species. It is natural that the essentials of this mechanism should be nervous rather than of any other character, since the responses which are required must depend upon nervous control.

There is little doubt, however, that other factors enter into the total situation; for example, the internal secretions of the sex glands or gonads, in the absence of which erotic appetite appears to be depressed or absent. Witness the disturbance of erotic desire in woman at the climacteric; or the usual frigidity of eunuchs. However, it has been noted in the latter case that if castration occurs after the male has passed puberty, the sexual impulse may manifest itself strongly in the absence of the gonads, so that internal secretions of these glands may be concerned more in the development of the mechanism of the instinct than they are in its operation.

92. *Conditioned Erotic Excitation*

In the "experienced" human individual, the initial stimulus to erotic appetite is usually of the *pattern* type, or—from the psychological standpoint—is perceptual. We have already indicated the high probability that sensitivity to such exteroceptive stimuli is not innate but acquired. To a normal man, it may seem an absurd idea that the intense visual attractiveness of the ideal, youthful woman should not have an innate foundation. The attraction to the opposite sex is almost always in terms of patterned stimuli, visual beauty, contoured tactual stimulation, and, sometimes, the quality or inflection of voice. Nevertheless, the evidence for innate heterosexuality in humans is not at all convincing when examined scientifically. The sexual preferences appear at an advanced stage in the individual's life, after he has been subjected to the influence of a complex array of environmental—including social—forces. We do not know what would happen to the sex tendencies of an individual who had been completely uninfluenced during the period from birth to puberty. However, the fact that homosexuality is so common, strongly suggests that the normal heterosexual preference is lacking in an hereditary foundation in human beings, and that its basis is actually that of social instruction or suggestion, combined—possibly—with an intellectual appreciation of the physiological suitability of the opposite sex as an instrument of erotic gratification. The merits of this suitability are of course convincingly demonstrated by a single experience.

The exact sequence of events when the sexual instinct is set off by a "perceptual" stimulus in the adult individual probably runs somewhat as follows. A visual, tactual, or possibly auditory pattern arouses the erotic center associatively, or in accordance with the principle of the conditioned reflex. This associative arousal sets off the reflexes of tumescence, which induce changes in the sexual organs, giving rise to intensified afferent excitation proceeding from the latter, and bringing about further excitation of the erotic center. We shall consider the details of the associative development of the sex instinct in later chapters.

93. *Excretory and Secretory Instincts*

The mechanisms of the excretory instincts, the desires to micturate or to defecate, have a rather obvious nature. In the case of the former, the afferent appetitional impulses arise from pressure between the walls of the bladder and its liquid contents. These impulses are referable to the excitation of pressure-sensitive receptors in the bladder walls, the same excitations being responsible for nerve currents which tend to set off the reflex of micturition. However, in the adult individual—although not in the infant—the pathway for these reflexes is blocked by an inhibitory action, emanating from higher centers (presumably the cortex). The mictural impulses disturb the cortex and produce a state of unrest, which continues until circumstances are found permitting the removal of the inhibition, after which the reflex proceeds, and the afferent nerve currents subside in consequence of the deflation of the bladder. In the case of defecation, the afferent appetitional nerve currents are to be assigned to the irritation of receptors in the walls of the large intestine by fecal matter contained therein. The reflexes of defecation are inhibited by the cortex or higher nerve centers, and are only released when the movements which arise from the appetitional impulses are successful in finding a proper environment for completion of the defecatory reactions.

It would seem that in the case of both of these instincts, we are dealing with an arrangement which has been superimposed upon a reflex in consequence of "experience." Thus, it appears that the child has to be taught to inhibit its excretory reactions, and that the necessity for unrest and seeking is a secondary consequence of the establishment of such inhibitions. In all probability, this is the correct explanation for the human species, but in the case of animals—such as cats and dogs—there seems to be a natural inhibition which develops when a certain age has been reached. These animals appear to be provided with reflex mechanisms, which cause them to scratch the ground prior to excreting; and to cover up their excrement subsequently. When circumstances are such that these reflexes cannot be carried out, there is an inhibition of the essential reflexes of excretion, unless the stimuli to the latter become excessively intense. In any event, the behavior of human beings or lower animals, under the influence of the excretory necessity, conforms to the pattern of an instinct or appetition, as we have defined it.

In the case of female mammals, subsequently to the bearing of offspring, the accumulation of milk in the mammary glands gives rise to afferent impulses—corresponding to a sensation of discomfort—which have an appetitional influence. These disturbing excitations may be expected to cause an unrest which will only be alleviated when they lead to nursing by progeny,—or, possibly, by a dairy-man in the case of cattle. The importance of this form of instinct in woman appears to be undetermined, although it offers a tempting sensory basis for the explanation of the so-called parental instinct, or love of progeny, which is certainly far more marked in the human female than in the male of our species.

94. *General Unrest, Fatigue, and Sleep.*

In addition to the specific appetitional instincts which we have analyzed above, there are in all probability other minor tendencies which we may need to invoke at a later period in our discussion, in explanation of phenomena which may not be accounted for by any of the desires we have already considered. It is to be noted that all of the instincts which we have considered may be characterized generally as *desires for a change.* The given physiological state is a source of relative dissatisfaction. This seems to be true even when the sensations which accompany the appetition are pleasant, as in the case of erotic desire. The given situation demands improvement. This generalization suggests that we may have to deal in some cases with a general impulse toward change. Any fixed state, whether of stimulation or of reaction, may tend to give rise eventually to unrest, which will not subside until the given initial condition is replaced by some other one. In the case of fixity of posture or movement, the appetitional effect may be ascribed to proprioceptive impulses which correspond to fatigue or muscular pain. They would thus fall under the general instinct or desire to escape from pain. However, the incessant repetition of visual or of auditory stimuli, in the absence of any associative reinforcement of their value, appears to lead to a desire to escape from them. Thus, we tire of familiar scenes and travel in the search of novelty; we move ourselves and our belongings from one residence to another for no other good reason; we arrange and rearrange the objects about us. Stereotyped forms of speech annoy us and lead to the invention of new instruments of expression in the form of "slang"; melodies become tiresome and new ones are sought. This tendency is concerned with "patterns" on the afferent side, but is not specific with respect to them, applying to all patterns whatsoever (with the reservation that they do not have an associative reinforcement of any kind). The cerebral basis of this general desire for change may be sought in something analogous to the fatigue of particular central mechanisms; looking at or listening to "the same old thing" continuously is cerebrally fatiguing. The state of unrest under these conditions is commonly called "nervousness."

It is probable that the nervous processes which characterize general organic fatigue, and which lead to a cessation of activity and to sleep, will have to be classed as appetitional. These processes may be traced in part to the excitation of receptors in the muscular tissues, but they almost certainly involve also a direct action of chemical substances, in the blood, upon the cells of the cerebral cortex and other brain centers. The effect of fatigue is similar in some respects to that of pain, in its interference with concurrent response, but it does not replace such response by new forms of activity. It brings about real inactivity, in the sleeping state. Although sleep seems primarily to affect the operation of the cortical response adjustments, and to provide the higher brain centers with rest, its real funcion is more probably that of relieving the general organic economy from the strain which the cortical unrest normally imposes upon the latter. The cortex is sensitized to metabolic end-products in the blood-stream, so that when these reach an unfavorable concentration, it is automatically drugged, and the organism as a whole is given a chance to recuperate. The "desire for sleep" is dependent upon this essentially central mechanism, and has a status similar to that of the craving for alcohol or other drugs, which act directly upon the tissues of the brain.

95. *Relations of Our Instinct Theory to Those of Others*

The list of instincts which we have considered above differs very considerably from those which are offered by the majority of advocates of instincts as a basis for the understanding of motivation. Our catalogue might be characterized as being crude and sordid, or sensual, in nature. Although such a description may constitute an attack from the moral standpoint, it is a strong recommendation from the standpoint of scientific analysis. If we are able to explain the more complex forms of human response upon such a primitive basis, the resulting logical system will be exceptionally meritorious, as evaluated in accordance with the indispensable principle of "parsimony."

However, our review of the fundamental instincts may prove to be displeasing to those who object to the admission of any instincts whatsoever, particularly in human beings. We may think, for example, of Kuo—with his "reaction units" and "response-postures"—or Allport—with his "prepotent reflexes." To such psychologists, we may say that it is just as well to try to retain a useful term like "instinct," if this can be done consistently with the preservation of any part of its ordinary denotation or connotation. On the other hand, it will be perceived that our actual agreement with such writers as Kuo and Allport is far closer than it is with such as McDougall or Hocking. Nevertheless, if we were to reduce McDougall's doctrine to the essence which is really tenable regarding purely innate response endowment, the result would not differ—at least in its implications—from the views which we have advocated above. In the development of our doctrine of motivation in subsequent chapters, we shall be led to doubt whether the conception of instinct is really a fundamental one.

We may now consider briefly how we shall dispose of some of the special instincts mentioned by McDougall and others, which are not included in our own catalogue. The first of the "principal instincts" as enumerated by McDougall, is that of "flight," which is correlated with the "emotion of fear." This instinct, as described, but not explained by McDougall, is an "experience" development from the pain appetition, involving also the reflexes which are innately linked with pain stimulation. Human beings, at any rate, have no definite reaction of "flight" and no "fear" of any particular kind of object or situation, as an hereditary equipment. The association of the skeletal movements, which are involved in "flight," with particular patterns of visual or auditory stimuli is a consequence of learning, under the tuition primarily of the pain instinct. The "instinct of repulsion," which is accompanied by the "emotion of disgust," is presumably an associative development of the nausea appetition. The "instinct of curiosity" (and "emotion of wonder") is probably a complication of the "desire for a change." The "instinct of pugnacity," which is correlated with the "emotion of anger," is a development of the pain appetition, with particular emphasis upon the reflexes of rage. We may expect pugnacious behavior particularly when the pain currents which are concerned are those which are derived from proprioceptive, rather than cutaneous free nerve endings.

The alleged "instinct of self-abasement" has no simple foundation, but depends upon the interplay of social conditions and a number of fundamental appetitions. The same proposition applies to the alleged "instinct of self-assertion." Whether a man or an animal is "self-abasing," or "self-assertive" will depend upon which of these types of reaction is successful in providing his organism with food, sex gratification, relief from pain, etc. The "parental instinct" probably has a similarly complex basis, although, as we have suggested above, it may have some special relationship to the nursing tendencies in the female. The instincts of "gregariousness, acquisition and construction" may be referred in a similar manner to the interplay of social conditions, or those of the natural struggle for existence, and primary appetitions.

In the earlier editions of his *Introduction to Social Psychology* McDougall showed excessive modesty in classing the "instinct of reproduction" as "minor," and of "ill-defined emotional tendency." (In later editions he compensates for this neglect.) Although it is difficult to agree with him on either of these points, there can be no hesitation in referring this "instinct," in its ordinarily conceived form to a development of the sex appetition. In a later catalogue, McDougall includes food-seeking, which has an obvious basis in hunger; and "appeal," which is a particular expression of the pain instinct; and "primitive passive sympathy," which can be explained as a natural consequence of associative principles. We shall consider all of the phenomena which McDougall and others explain on the basis of these alleged special instincts in subsequent chapters.

It will be perceived that the instincts which we have assumed in this chapter have no direct response specificity, in the sense that a particular object or form of stimulus energy sets off a predetermined motor reaction. We have not denied that such innate response mechanisms exist, but we have relegated them to the class of reflexes. However, instincts as we have described them have an innate specificity of another kind. The particular sensory channels which they involve are innately arousable by specific stimuli or organic conditions, and heredity provides them with the power to disturb the cortex or higher nerve centers so that random movements ensue. In these conclusions, we agree generally with McDougall's characterization of instinct in his *Outline of Psychology*.

Although the random movements in pristine instinctive action are characteristically indeterminate, it is not necessary to deny that there may be some degree of selection or "weighting" of the chances. Such an effect does not seem to be essential, however, and should be assumed only when direct experimental evidence demands it. The nature of the motor reactions, which succeed in removing the disturbing afferent nerve currents that set off the appetition, will depend, in the majority of cases, upon the environment in which the organism is forced to act. Consequently, we should not be surprised at the lack of determination of the reactions by heredity. Thus, a stray cat can best satisfy its hunger by hunting birds or mice, whereas a domestic animal can achieve the same result more efficiently by crying. Nevertheless, instincts have a certain specificity with respect to the efferent side of the process for which they are responsible, in that they select and "stamp in" the particular form of response which terminates them. An understanding of the mechanism of this selective process is one of the main problems which lies before us. As an introduction to the study of this problem, we must consider in greater detail the properties of the cerebral cortex.

Chapter X

The Characteristic Properties of the Cerebral Cortex

We have seen in a preceding chapter that probably the most fundamental determinant of the specificity of reflex response consists in the pattern of anatomical conjunction of the afferent and efferent nerve fibres. By virtue of the arrangement of these conductors in space, the incoming nerve currents which are aroused by the stimulus are led to a definite position,—that of the reflex adjustor—and this, in turn, is conjoined to the conductors for the out-bound impulses, these being conveyed, as a consequence of anatomical continuity, to the appropriate muscles. However, we have seen that the continuity in this circuit is interrupted to some degree by the presence of synaptic separations between the nerve units. In explaining the principle of *syntony,* we have also suggested that the afferent impulses may sometimes reach adjustors or efferent nerve paths which they do not always affect. Moreover, we have seen that synapses or adjustors may themselves vary in sensitivity so that the anatomical conjunction, although given, is frequently ineffective for this reason also.

96. *The Irradiation of Nervous Excitations*

Now a careful study of the anatomy of the nervous system, even at its lower levels such as the spinal cord, shows that some degree of anatomical connection exists between any afferent nerve channel and all motor outlets. Also, all afferent channels have potential connections with any single efferent unit. There is a possible pathway, sometimes devious, between any receptor and any effector point. That this apparent universality of interconnection is not a mere appearance is demonstrated by definite physiological evidence. The most striking corroboration is found in cases of strychnine poisoning, where stimulation of a single sensory point may suffice to produce a contracture of all of the muscles. However, similar effects of a less extensive character can be observed under normal conditions. The phenomenon of immediate spinal induction, which we have discussed above, through which reflexes may reinforce one another, involves a spreading out of afferent energies beyond what might be considered their normal limits within the spinal cord. A still stronger manifestation of this tendency appears in what is known as *spinal irradiation.* In accordance with the principle of this process, an increase in the intensity of the stimulus to a reflex, is followed by a spreading of the motor manifestations about their original low-intensity center. The spatial paths of the irradiation do not necessarily form a symmetrical figure around the original center, but follow rather definite rules, such as those enunciated by Pflüger, which indicate that the nerve network is more conductive in certain directions than in others. In addition to the phenomena of irradiation, we may note a tendency for any powerful afferent excitation to affect, to some degree, all concomitant motor processes.

97. *The Rôle of Differential Resistances*

In order to understand these phenomena, particularly in combination with the normal specificity of individual reflex mechanisms, we must conceive the nervous system as a universally interconnected network, but having a quantitative arrangement of resistances. The resistance between a given sensory point and the effector which expresses its characteristic reflexes is relatively low, whereas the paths which connect it with other effectors are of relatively high resistance. Accordingly, the excitation which proceeds from such a receptor will not reach the secondary effectors unless it is sufficiently intense to overcome the higher resistances. The spreading of such an excitation will be determined by the distribution of resistance among alternative paths and will thus depend in a definite manner upon the characteristics of the given network.

Thus far, we have been considering the response processes which occur exclusively via the spinal cord, and are exemplified perfectly in an animal which has been deprived of all higher nerve centers. If, now, we study what happens in a complete nervous system of the higher vertebrate type, we find that processes analogous to irradiation are of paramount importance. Moreover, the limitation of conduction to restricted paths through the higher levels of the nervous architecture is due, primarily, to the exact distribution of resistances among the paths, rather than to the pursuit of exclusive anatomical connections. In the first place, we find that an afferent excitation will nearly always be transmitted to each of the levels in the hierarchy. It may act directly through the spinal level to produce a reflex discharge, but at the same time it will pass to higher centers and there will generate secondary efferent currents, which may modify the spinal reaction or superimpose other motor effects upon it.

98. *Characteristics of Conduction Through the Cortex*

We have already noted that the highest level of nervous transfer or adjustment is to be found in the cerebral cortex. Nerve currents which pass through this center follow the longest paths, the greatest number of individual nerve conductors, meet the highest resistances, and are most unreliable as to their motor outcome. The operations of the cortex illustrate certain principles which are also probably concerned to some extent in the processes of the lower centers, but which become preëminent only at the cerebral level. Adjustor levels which are intermediate between the cortex and the spinal segments may be, to some extent, intermediate in their dominant principles, but the difference between the cortex and the next lowest level (exemplified, say, by the thalamus) is very great. Hence, we are justified, qualitatively, in saying that the adjustor processes of the cortex are subject to unique laws of determination.

We have already seen that the cerebral cortex receives incoming fibres or currents from all of the sensory surfaces of the body, and, in turn, gives off motor conductors which pass to all of the voluntary muscles. We have noted, however, that there are myriads of associational interconnections between these two groups of nerve paths. Now the connections between the sense-organs and the sensory projection areas of the cortex are determined by a very strict principle of anatomical conjunction. The pathways of conduction between the motor projection areas and the subcortical motor centers—and eventually the muscles—are also governed strictly by the same rule. Within the cortex itself, however, the anatomical interconnections are so numerous as to constitute a universal nerve-net between all points in the two respective classes of projection areas. In other words, so far as the anatomy of the cortical system is concerned, we might expect a perfectly general spread of nerve currents from any sensory projection point to every motor projection point, so that all of the muscles of the body would be energized through the cortex as a result of the slightest excitation of any receptor whatsoever. The fact that this does not actually occur under normal conditions indicates that the cortical pathways interpose a *high resistance* to the passage of nerve currents, and that the resistances along alternative paths are quite unequal. Hence, we may say that although the cortex establishes universal potential connections between the afferent and efferent conductors, the actually operative connections at any time are very greatly restricted by resistance factors. It is to be presumed that these resistances are localized primarily in the cortical synapses, of which there are countless numbers.

The general manner in which a distribution of resistances can determine the exact path of conduction through any conducting network should be fairly obvious to the reader. However, it may be well to devote a few words to an analysis of the process for the particular case of a *nerve* net. If we were dealing with a fabric of electrical or fluid conductors, we should find that conduction takes place simultaneously through all existent pathways, the strength of the current in any pathway being, however, inversely proportional to the local resistance. In the case of nervous conduction, however, the units act in accordance with the principle of the threshold and the "all or none" law. The threshold principle implies that unless a certain critical value of the impelling conduction pressure is reached, there will be no conduction whatsoever, while the all or none law demands that the response to any pressure, no matter how great, shall never exceed that which is developed at the threshold. In other words, the influence of resistances and of excitatory pressures upon nervous conductors ordinarily determines whether or not any conduction whatsoever shall occur, but is without bearing upon the quantitative aspects of the conduction process when once the latter has been initiated. There are some complications of this principle which are required in order to explain the apparent dependency of the intensities of neuromuscular processes upon stimulus magnitudes; but, disregarding these for the time being, we may say that the distribution or pattern of resistances throughout the cortical association network will operate primarily to determine which among all of the possible lines of conduction will actually function, the process along this line being of maximal intensity if it occurs at all, whereas other conceivable pathways will be entirely quiescent.

99. *The Importance of Excitation Pattern*

Now the second prime distinguishing feature of cortical conduction consists in the dependency of the motor outcome upon the exact *pattern of the afferent impulses.* We have already discussed the general notion of nerve excitation pattern in a preceding chapter, and have seen that it must be a feature of any response process which involves a plurality of simultaneously functioning nerve paths. It is by no means our intention to imply that pattern is entirely absent, or unimportant in subcortical response processes. It is evidently of prime importance on the *efferent* side at all levels, since it determines the "figure" of the reaction in space and time—the posture and movement of the organism. Also, if we regard the entire system of afferent conductors in their relationship to all possible reflexes, we see that the exact distribution of stimuli over the system in question is a primary determinant of the motor result. Even within the domain of a single kind of reflex, the exact pattern of stimulation exerts an influence, as shown, for example, in the tendency of the scratch reflex to apply the claws to the particular spot on the skin of the dog's back which has been stimulated.

However, there is never any such radical dependency upon pattern as we find in the case of cortically regulated reactions, since in the latter case very slight changes in the configuration of the stimulus frequently result in a tremendous transformation of the reaction, shifting the center of the motor disturbance from one muscular region to quite a different one, or completely altering the character of the motor innervations. For example, there may be relatively little difference between the patterns of retinal excitation which we receive when we look at two different faces, but our reactions to them may be as far apart as the poles. In one case we may embrace the person whom we see and in another case, turn away. The general principle that any sort of behavior difference may be founded upon even the least perceptible difference between stimuli is evident in the general notion of voluntary behavior in everyday life.

Now, it may not be strictly true that the nature of the motor discharge from the cerebral cortex along the pyramidal neurones is entirely determined by the pattern of the afferent excitation on the sensory projection areas. A good deal depends upon the exact manner in which we define the term, pattern. We have, however, stated what is certainly the predominant principle of the cortical adjustor process. Very little is determined by the mere fact that the incoming impulses are visual, auditory, olfactory, and the like; the essential point is that of the configuration of the incoming excitations over the fields in question. However, their intensities and qualities are necessary features of the pattern and in some cases, such as the olfactory, there seems to be no complexity of configuration, the entire mode of variation being qualitative or intensive. The regulation of behavior with respect to purely qualitative differences may be viewed as another aspect of the discriminative sensibility of the cortical adjustors, which also enables them to be so sensitive to variations of pattern. Fine discriminations with regard to gradations of intensity furthermore differentiate the cortical from the subcortical adjustments;[129] although, as we have seen, the latter are frequently responsive to intensity changes. We may note, also, that the cortex deals very delicately with types of stimulus change or movement, constituting characteristic *patterns in time,* or in both space and time together. Usually, in cases of cortically adjusted response, we are concerned with the total pattern which is formed by all afferent impulses in combination, since as a rule the outgoing innervations are founded upon an integrated resultant of all given sensory nerve currents.

The question as to the general mechanism by which the efferent nerve currents are regulated with respect to the pattern of the afferent excitations is one which has thus far received very little attention, and has been given no satisfactory answer.

100. *The Basis of the Variability of Cortical Responses*

The third characteristic feature of cortical response adjustments consists in the lack of uniformity of cortical response specificity between different individuals of the same organic species. This failure to follow a type is closely associated with the variability of the cortically controlled responses in the course of a single individual's biography. These features lead us to conclude that, for the most part, the specificity of cortical adjustment is determined by influences operating during the lifetime of the individual—and largely peculiar to his own circumstances—rather than being dependent upon details in his heredity. Of course, this does not mean that hereditary factors of a general nature are completely ruled out, since they are necessary to furnish the foundations for what is built up during the lifetime of the individual.

101. *Cortical "Trial Responses" and Their Selection*

Accordingly, we are faced with the problem as to the mechanism by which the specificity of cortically determined response is settled at any time in any individual. The attempt to solve this problem will be one of the main endeavors of the present book, but for the time being we shall only suggest the general nature of the solution which will be developed in greater detail in later chapters. We shall suppose that in the infant, embryo, or ideally "inexperienced" individual, the various alternative paths of conduction through the cortex are of substantially equal resistance, so that the individual is practically without cortical bias or specificity. However, the balance between the different paths cannot be mathematically exact, and various organic conditions operative within the cortex (such as variations in the circulation of the blood, its chemical composition, etc., the temperatures of various parts, or possibly some more definitely nervous factors) are constantly causing small local changes in resistance. Consequently, under the influence of excitation pressure from the afferent side, nerve currents break through the cortex and give rise to predominantly random motor reactions. These reactions are "random" in the sense that they are the outcome of fluctuating forces and have no reliable relationship to the biological needs of the organism at the given moment. But they will ordinarily show a high degree of organization on the motor side, since the cortex utilizes the hereditarily founded coördination systems of the lower motor centers. Thus, when a child reacts to the moon by reaching for it, it does something which is absolutely ineffective and original, but the grasping process is fairly well coördinated because its details are controlled by an hereditarily well-established mechanism in the medulla or spinal cord. The essential point, however, is that the cortex has initiated a random connection between a given afferent pattern and a particular efferent pattern.

Initial cortical adjustments to a given stimulus are not always wholly random in character. It is only the most primitive trials at response which must be regarded in this manner. As soon as the cortex has built up any appreciable store of successful adjustments or mechanisms, the new trials will probably be influenced to a considerable degree by the patterns of existing schemes. Köhler's observations concerning "insight" in the higher mammals, especially in the apes, suggest that it may be possible for the pattern of the stimulus to determine that of the reaction, through the medium of an hereditary interrelationship between the two fields of innervation. However, it is more likely that the ability of the apes to make an initial response, which is sufficiently correct to yield success, is due to the general similarity of the given stimulus situation to others which they have previously encountered successfully, but with less "insight." In other cases the actual products of one process of learning are subjected to the action of a subsequent selective process in a changed situation, where they may have lost their original biological utility.

Any initial cortical adjustment results, from the standpoint of behavior, in a so-called "trial"; and the question must be settled as to whether this trial is an "error" or a "success." If it is an error, the exigencies of the biological situation demand that it should be eliminated or suppressed, but if it is a success it needs to be retained as a permanent form of response. Consequently, the nervous system must supply through heredity a *mechanism of selection,* to operate upon the random concatenations of afferent and efferent patterns which are generated in consequence of the cortical spontaneity. Numerous psychologists have suggested that such a device is provided by *pleasure and pain;* but this principle requires a definite physiological interpretation in order that it should become a legitimate portion of our present theory. We shall later endeavor to show that the essential distinction is that between nociceptive and beneceptive processes, in contrast with other response mechanisms. But for the present we shall disregard the problem as to the historical basis of the cortical mechanisms and shall confine ourselves to their probable nature as they exist at any given time.

102. *Afferent-side Cortical Operations*

Now, although the cortex receives fibres from all of the sensory surfaces of the body, whether external or internal, its adjustments are concerned in preponderant measure with nerve currents which represent what is going on in the environment, or which symbolize the relationship of the organism to the latter. Undoubtedly the most important of these groups of environmentally determined nerve currents are those of the visual sense. The importance of this sense, particularly as a pattern-determining device, is evidenced by the fact that the two optic nerves carry a much larger number of individual conductors than are comprised by all of the other afferent nerves of the body put together. At every moment, the visual sense projects upon the cortex a detailed, even if a radically distorted, picture of what is transpiring before the eyes. We know not only that a special area of the cortex is reserved for the reception of the visual currents, but that adjoining areas are devoted to operations upon, or elaborations of, these currents in the interests of eventual motor regulation. The identification and isolation of these adjustor operations in the present state of our physiological technique requires the introduction of psychological criteria, which involve us in the theory of *perception.* However, we cannot be enjoined from regarding the psychological functions as indices of corresponding physiological operations, even if we are unable to describe the exact character of the latter. We are at any rate able to localize them fairly definitely within the cortex, and to show that they can be influenced individually by purely anatomical or physiological changes, such as those which occur in disease or injury of the brain.

In the case of vision, we are justified in affirming the existence of cortical adjustor operations which accomplish the following things, among others: (1) the combination of the impulses from the two eyes or retinas in accordance with the principle of "corresponding points," to produce a single, integral process, (2) differentiation between the two retinally determined patterns with reference to dissimilarity in form, and the development on this basis of a feature of the adjustor process which represents the distances of objects from the eyes, (3) treatment of the nerve currents with regard to their similarity to previous excitations, on the basis of records impressed by the latter upon the cortex, resulting in a classification of present excitations in terms of previous ones, (4) the relative isolation within the total pattern of more restricted excitation groups, corresponding to significant (or biologically important) lines of cleavage (such as the distinction between an object and its background), (5) combination of the visual excitations with those derived simultaneously from other senses, (6) the arousal of records in visual or other regions which are associated with those corresponding to the present excitations in consequence of prior "experience," (7) and a general integration of the components of the excitation, combined with enhancement of the more important differences between its parts. These operations may be regarded as following one another in serial order and as constituting —at least in part—what we may designate as the *afferent sector of the cortical adjustor process.*

A similar series of operations may be regarded as applying to each of the other groups of afferent impulses, including the auditory, gustatory, olfactory, tactual and general "somaesthetic" (or bodily) sense currents. In the case of audition we are particularly concerned with the processes which underlie language, and which comprise *verbal* elaboration. The language mechanisms of course also involve vision (in reading), touch (in writing), and kinaesthesis (in the movement of the vocal organs) as well as audition; but the greatest application of the auditory sense in human life is undoubtedly to the reception and understanding of words, whereas the other senses have a relatively wider bearing upon non-verbal matters. For our purposes it is not necessary to go into the details of these auditory cortical adjustor processes, which have been discussed in masterly fashion by Piéron, in his work, *Thought and the Brain*.

103. *Efferent-side Cortical Operations*

The efferent side of the cortical adjustor process probably has a corresponding complexity of phases. This efferent side may be conceived to begin at that point in the cortical conduction at which the operations upon the afferent currents are complete. It can hardly be supposed that the outcome of such operations will furnish a natural basis for the appropriate motor discharge. Control of the latter must be worked up independently, and then attached by a comparatively arbitrary relationship of association to the finished sensorily determined process. If this proposition does not seem evident from the nature of the nervous activities themselves, its truth must at least be observed to follow from the fact that the complete afferent-side outfit with its manifold integrations, differentiations, etc., can be divorced bodily from any given motor expression and attached to any other one, without suffering any essential changes within its own constitution. This proposition is based of course upon the psychological observation that our perception of a thing is practically independent of the nature of our behavior with respect to it. Thus, an orange does not look very different when I use it as a baseball rather than as an article of food.

The termination of the efferent side of the cerebral adjustor process may be regarded as beginning at the point where the adjustor fibres make contact with the pyramidal cells in the motor projection area. The direct stimulation of this area in animals, or in man (by means of electricity), shows that there is a definite position within the area for each of the larger groups of motor units. For example, there is a spot at which only movements of the thumb can be brought out, and another which controls the facial muscles. The amount of surface which is reserved for the control of any motor member depends upon the importance of the latter (as indicated by the complexity of its behavior) rather than upon its anatomical size. Now, as we have already indicated, artificial stimulation of the motor area of the cortex gives rise to movements which, from the standpoint of the muscles themselves, are complex and coördinated. They do not, however, possess the complexity and specificity of so-called voluntary movements which result from normal cortical adjustments. Consequently it follows that the exact pattern and sequence of innervations which are normally supplied to the pyramidal cells requires a specific complexity on the efferent side of the cortical adjustor process.

This is indicated, furthermore, by the fact that normal voluntary movements are completely upset by the removal of the controlling influences of the afferent impulses which reach the cortex from receptors in the motor parts and the skin of the moving member, whereas the suppression of these afferent impulses has no effect upon the reactions which follow from direct excitation of the pyramidal region. We are justified in supposing that the organization of the motor control involves a considerable number of stages in the cortex, just as it does in the subcortical portion of the total outgoing process. The term "incito-motor" has been used by Piéron and others to designate the mechanisms and activities occurring in the motor cortex. This term indicates that the pyramidal fibres are not complete determiners of motor activity but, rather, are concerned in its release. It would seem appropriate to apply the name, *incitation,* to the entire efferent-side activity of the cortex, including adjustor (associational) as well as strictly pyramidal processes. Some interesting views concerning the organization of this incitation process have been advanced by Southard.[130] Reference should also be made to C. J. Herrick's recent, very thorough, discussion of the functions and evolution of the cerebrum in his admirable book, *The Brains of Rats and Men.*

As a corresponding name for the afferent-side activities of the cortex, we may propose the term, *entegration* (suggested by entrant and integrate).

104. *Features of the Cortical Adjustors*

It will be noted that the arrangement, which we have thus depicted, harmonizes with our previously expressed ideas concerning the convergence of afferent impulses upon the cortical centers, combined with a divergence of motor control currents therefrom. The focal point of the convergence will evidently be the terminus of the entegrative activity, which is adjacent to the point of radiation of the efferent cone of impulses. Psychological considerations lead us to believe that the completion of the entegrative activity does not result in a wholly unified process, but involves the simultaneous coöperation of a very large number of neurological units. Similar reasons also suggest that the cone of the incitation process has a much narrower apex which corresponds in location to some particular portion of the final entegrational phase; usually the section of the latter which represents associated motor-sensory or proprioceptive impressions. The simplest psychophysical relationships exist if we suppose that the introspective consciousness is correlated exclusively with the final stage of the entegrative activity, and does not penetrate any appreciable distance into the cone of the incitation process.

The anatomical location of the focal point in the cortical adjustor mechanism is undoubtedly to be sought for in the association regions of the cortex. However, there is no reason for supposing that the focus maintains a constant position within these areas. On the contrary, the most reasonable idea is that its location is subject to constant change, thus permitting each specific kind of activity to appropriate anatomical units which are more or less exclusive, and to record its own tendencies within this combination of units. However, we certainly do not mean to imply that there is no overlap of units between different records of this sort. It is necessary to suppose that the record resides in a complex constellation of nerve cells, and not in any particular individual components. It seems entirely reasonable to believe that whenever any particular specific response is exactly repeated, the same anatomical configuration of nerve paths is involved, so that the focus will lie in the same portion of the brain which was previously occupied when this process occurred. We should not expect, however, to find any very great correspondence between the localizations of similar adjustments in the brains of different individuals, and it is entirely conceivable that the same kind of adjustment may sometimes be mediated by two anatomically separate mechanisms; as in a case of complete forgetfulness or lapse of habit, followed by relearning. Nevertheless, generally similar types of entegration or incitation usually occupy generally analogous areas in different brains of the same species, as evidenced by the definiteness of the areas which are devoted to the language function in the human cerebral cortex.

Now, in carrying out its adjustments between afferent and efferent currents, the cortex is undoubtedly subject to the influence of subcortical and extra-adjustor forces (within the cortex itself), which do not find adequate representation within the afferent pattern. The given adjustor system is forced to operate in an environment which comprises the mechanisms of many other adjustments, all of which are active or potentially active to some degree. The anatomical units that are concerned in many of these adjustments are probably identical with certain units in the operative adjustment, or interlace closely with the latter. Moreover, we may suspect that reinforcing or inhibitory impulses are constantly arriving at the cortex and acting directly upon the adjustor processes, from such regions as the thalamus. Consequently, we must not expect to develop a complete explanation of any cortical adjustment on the basis provided exclusively by the self-evident elements of this process alone. The dominant adjustment at any time necessarily has a dynamic relationship to all other coexistent nerve activities, of which there are a great many.

105. *Cortical Records or Neurograms*

Something further needs to be said concerning the question of records within the cortex. The general notion that such records exist has been a prevalent one among physiologists and psychologists for centuries, but animistic thinkers have frequently denied their possibility or effectiveness. Certain other thinkers have undoubtedly upon occasion conceived of these records in too crude a fashion, comparing them directly to imprints, photographs, or phonographic impressions. Nevertheless, the notion of a *neurogram*—to use Morton Prince's expressive term—still remains indispensable to a purely physical understanding of what happens in the cortex. We are entirely justified in supposing that any given cortical process can leave behind it such a modification of the nervous substance that the reactivation of the substance will tend to take a form which reproduces the original process. This is the general law for all material records, phonographic, photographic, magnetic, or otherwise. If we knew more about the details of the adjustor mechanism, we should be able to form a clearer conception of these records. It seems almost certain, however, that they will involve, among other things, changes in the synaptic resistances, because the records always involve the establishment of preferential conduction along certain paths. Furthermore, on account of the pattern principle of the cortex, we can feel certain that each record involves a large number of anatomical units, which will tend to be aroused simultaneously when the record again becomes operative. This is the underlynig basis of the principle of *redintegration,* according to which the arousal of a sufficiently important section of any original neurological excitation pattern will normally entail the rearousal of the entire pattern.

It is consistent with the above considerations that the cerebral cortex should be the principal locus of learned response in the nervous system. In the new-born animal—or, possibly, we should say, in the embryo—the cortex is a neurological *tabula rasa,* upon which certain forces which appear in the later life of the individual can write response records. It is not necessary, of course, to insist that the pristine cortex is absolutely free from anatomically determined lines of conduction. In fact, we know that its anatomy is fairly definite in any given species, and we should expect that some degree of hereditary bias would exist on this account. Moreover, we need not assume that all of the subcortical centers are entirely incapable of developing specific response on the basis of non-hereditary factors. However, the contrast between the cortical and subcortical mechanisms in respect to the modifiability or fixity of behavior is extremely great. Although there are plenty of examples of learning or of habit formation even in animals having no nervous systems whatsoever, nevertheless "docility" appears to increase practically in direct proportion to the relative development of the cortex as compared with other portions of the nervous system, as we pass along the evolutionary scale from the protozoa to man. Moreover, extirpation of the cortex or cerebrum in the *highest* animals practically eliminates the possibility of learning and reduces the animal to a purely reflex level of behavior.

If we adhered to strictly behavioristic assumptions, we might be compelled to limit the functional nature of cortical records to interconnections between incoming and outgoing nerve currents. This would be the sort of record which could be most readily described in terms of lowered resistances, presumably at synapses. But psychological considerations lead us to believe that records can be made which represent the sensory or afferent-side adjustor processes independently of any connection with particular motor outlets. Every afferent pattern which arrives at the cortex leaves its impress, and if we disregard the *a priori* requirement that all incoming currents should find a way out, we shall be able to recognize that relatively few of these incoming patterns arouse definite motor reactions. Another kind of record is to be found on the incito-motor side of the cortex in the form of mechanisms which engineer certain characteristic forms of voluntary behavior. These efferent control systems are built up through exercise or practice in relation to some particular afferent currents, but can readily be divorced from their initial associates and subjected later to the control of quite different afferent excitation patterns.

106. *Relations of Innate and Acquired Attributes*

In thinking of the relationship between cortically and subcortically controlled responses, we should be careful not to draw too exclusive a distinction between behavior which is determined by heredity and that which is a consequence of learning. There is certainly no learned response which also does not derive many of its features from heredity. The fundamental action units which can be energized from the motor area of the cortex are for the most part laid down by heredity. The general principles in accordance with which the incitation mechanisms of the cerebrum are built up must also be hereditarily determined. Similarly, the entegrative activities of the cortex must rest upon general hereditary foundations, and the paths of conduction from the sense-organs to the cortex are certainly mapped out by congenital agencies. Whatever form of response we may be considering, we can be certain that it is not so much dependent upon a *sum* of innate and environmentally induced factors, as upon an arithmetical *product* of such components. Almost any concrete moment in the life of a complex organism, such as a human being, involves the simultaneous coöperation of numerous response arcs, some of which are due, almost exclusively, to hereditary forces, whereas others, which combine with these in a very intimate way, are largely attributable to learning. Consider, for example, the course of any complex emotional reaction, in which the initial phases usually involve something which has been learned, but the intermediate and concluding processes incorporate a large number of purely reflex responses, along with higher center reverberations that are more individualistic in character.

Chapter XI

The Mechanism of Learning

The next problem to which we must direct our attention is that of the process by which lines of specific conduction, or response control, are laid down through the cerebral cortex. This problem is substantially identical with that of the physiological nature of *learning*. We have already reviewed some current theories regarding this process in our discussion of doctrines of animal motivation. Our present task is to consider these views more critically and to endeavor to develop a satisfactory theory for the purposes of our own discussion.

107. *Résumé of Extant Theories of Learning*

The reader will recall that experiments upon animals, supplemented by observations upon human beings, have suggested the following explanations of learning.

In the first place, all authorities agree that if nervous conduction occurs through a path, this path is thereby reduced in resistance and will conduct more freely in the future. This is the principle of use, exercise, or practice. Furthermore, it is pretty generally agreed that primitive learning requires a principle of random movement or "trial and error" response. The organism must be able to "experiment" with its reactions in order that it should succeed in the adoption of satisfactory behavior in any given situation. The essential problems in connection with learning of this sort appear to be, first, that of the physiological basis of "random movement," and, second, that of the nature of the process of "adoption," "stamping in," or "learning by experience."

We have seen that the majority of psychologists have attributed this fixation process to some feature of the satisfaction of instincts, appetites or desires. Thorndike has formulated the effect in terms of pleasure-pain, comfort-discomfort, or satisfyingness-annoyingness. Watson appealed to "frequency and recency," but not without involving the instinctive factor as a condition; Washburn to association with prepotent reflexes or the removal of the state of unrest which characterizes the operation of instinct. Doctrines which are closely similar to those of Washburn have been advocated by Hobhouse,[131] Holmes,[132] Peterson,[133] and Smith and Guthrie.[134] We shall consider some of these theories in detail, below. They all point to real aspects of the learning process, but from the standpoint of the present writer, they all display a surprising blindness to a very simple explanation which the phenomena of learning by experience should suggest to anyone who is acquainted with the principles of modern neurology, as well as with the opinions of common sense.

108. *Various Kinds of Learning*

Before proceeding to discuss the process of trial and error learning, however, we should consider certain other mechanisms of neural impression, real or alleged. We have seen in the preceding chapter that the cerebral cortex is presumably able to receive and to retain impressions of exact patterns of afferent nerve excitation without linking these impressions or excitations with any particular motor innervations or reactions. The simplest kind of learning would seem to consist in the mere recording of such patterned impressions upon the cortex. Such learning does not involve the formation of habits and, in itself, cannot be detected by purely behavioristic observations. A large part of what passes for education consists in the laying down of purely afferent records of this sort, which never express themselves in the behavior of the individual. Their failure to gain such expression results from the fact that they have no natural relationship to the principles of motor control. In order for such "expression" to appear, an arbitrary association must be established between the afferent patterns and particular efferent ones. The means by which such connections are made constitute our most interesting problem. The laying down of afferent records in the cerebral cortex may be attributed to the principle of exercise or the opening up of a certain pathway as a consequence of the mere incidence of nervous energy.

The conception of learning which predominates both in common sense discussion and in psychological research is that of the process by which particular kinds of motor reaction become connected with specific stimuli. There is one case in which this can apparently be accomplished by the mere formation of an afferent excitation record. This is the case of the generation of a conditioned reflex. We assume in the beginning that there is an hereditary connection between a certain stimulus and a particular reaction. Then a purely afferent process can lay down a patterned record in the cerebral cortex which simultaneously involves or includes as parts, first, the innately operating stimulus in question and, second, certain other stimulus factors. The pattern which is thus formed makes it possible for the new afferent or sensory component to set off the efferent reaction because it has become associated with an afferent element which already has this specific motor connection. In this process, it is unnecessary to form any new liaison between the afferent and efferent sides. Learning in accordance with this principle plays a very important part in the development of response in the individual.

Another aspect of learning which is emphasized in popular thought seems to have a purely efferent character: the acquisition of skill. Such acquisition involves the perfection of incito-motor mechanisms and their accessories. However, it is to be doubted whether this process is ever exclusively efferent in nature. Certain kinds of skill very obviously involve the evolution of a close coördination between sensory and motor factors as, for example, in marksmanship. In other cases, as in playing a musical instrument, —without reference to a score—the mechanism may seem to be exclusively motor, but closer examination shows that it actually involves proprioceptive and tactual afferent nerve currents, in an intimate manner. When these afferent impulses are eliminated, the reactions become impossible. The skill of a white rat in running a maze is independent of visual, auditory or olfactory stimuli, but is believed by Watson to rest upon proprioceptive or kinaesthetic impressions; and in such case, is not an exclusively motor acquisition.

In the case of human beings, there are certain supposed methods of establishing specific response, or particular connections between stimuli and motor reactions which do not seem to follow the plan of trial and error learning, as observed in animal experimentation. One of the commonest methods of attempting to establish habits in children is that of verbal instruction, command, or "telling them what to do." The principle of this form of teaching appears to be as follows. First, certain words must be associated with the stimulus and with the reaction, respectively, so that the individual "knows the meanings of the words." Second, a sentence in the form of an admonition or command, is presented to the "pupil," which links together the name of the stimulus with that of the reaction. There must, also, as a rule, be a name for the individual who is being instructed and this must be included in the instructions. Ordinarily this name is "you."

Sometimes this verbal method of establishing a reaction appears to be very effective. Its effectiveness may be a measure of what we call the "suggestibility" of the individual, that is his tendency to be governed in his behavior by verbal formulae. However, in the case of children—and, particularly, very young children—the method is singularly ineffective. It obviously cannot be applied to infants or those who are incapable of appreciating the significance of words, because they have never successfully associated them with objects, situations, or the like. But, even when the instructions are "understood," it is ordinarily necessary to add further verbal formulae, which usually take the form of promises or threats, representing some sort of reward or punishment. Even with these accompaniments, the instructional method may fail entirely.

It is evident that the basis of this most commonly accepted method of human control is rather complicated and depends upon the establishment of a considerable amount of "experience," in the form of associations, before it can become at all effective. Consequently, we shall be justified in postponing a detailed analysis of this scheme until we have arrived at a satisfactory explanation of a means for teaching which will apply to infants or to animals.

Another somewhat more primitive device, which has been used somewhat successfully with animals, but with considerable less success in the case of children, is that of forcibly putting the organism through the movements, which it is desired to have executed, while in the presence of the appropriate stimuli. Thus, we may endeavor to teach an animal how to get out of a problem box, by dragging it or leading it to the right part of the box and then manipulating its limbs so that it operates the latch or other releasing device. As a rule, this scheme is not very effective, because the associations which it establishes in the animal or child are quite different from those which are desired by the instructor. The difficulty is that we may not be able to secure active motor innervations through the cortical centers, corresponding to the forced postures or movements. Even the proprioceptive currents which arrive at the cortex will not be the same as those which would be generated if the movements were active, instead of being passive. Nevertheless, there may be some degree of similarity between the proprioceptive impulses in the two cases, which will serve to aid in the establishment of the desired interconnections between afferent and efferent activities.

This leads us to consider the interesting relationship which necessarily exists between proprioceptive and the corresponding efferent nerve currents. On account of the nature and location of the proprioceptors, they must be set off in patterns of excitation which correspond with the form of the given motor innervation. These proprioceptive configurations arrive, in most cases, at the cortex while the motor innervations are still operative. Consequently, an association will inevitably be established between each specific form of motor incitation and the corresponding proprioceptive, afferent pattern. It is, undoubtedly, for this reason that the proprioceptive configurations become the keys to the selection of particular kinds of movements, from the afferent side. Just as soon as the organism begins to experiment with its motor apparatus, it starts to lay down proprioceptive or kinaesthetic records in the cortex, which may be presumed to have afferent-efferent connections with the corresponding motor incitations. Thus, it has ready for use by the more advanced forms of learning, a repertory of afferent cortical neurograms which are in dynamic correspondence with an equal number of motor control systems.

Two other methods of learning or teaching which are commonly employed in human education are those of *imitation* and *reasoning,* respectively. Imitation involves the duplication of movements which are seen or otherwise represented in a non-motor fashion (possibly only by verbal description), and therefore requires a relatively direct translation of afferent patterns to efferent ones. This may possibly take place through the intermediation of proprioceptive or kinaesthetic factors. Learning in this manner has been noted among the lower animals as well as in men. It is particularly frequent in the case of apes, as shown in the studies of Köhler; and evidently plays a part in the fixation of characteristic songs in birds. Like the other popularly considered methods of instruction, the neurological basis is complex and consequently we must postpone its detailed consideration. Learning by reasoning is the most complex of all of the methods by which we perfect our forms of response. This method seems to be a peculiarly human device, which is probably due to the fact that it depends essentially upon language or symbolism. We shall consider some details of the process at the appropriate point in our argument.

109. *Various Theories of Trial and Error Learning*

Psychologists agree generally that the fundamental method of learning—among men as well as among the lower animals—is that of "trial and error" response. Other schemes for the establishment of beneficial reactions to given stimuli rest ultimately upon the foundations laid by this procedure, together with the principle of the cortical recording of total afferent patterns in conjunction with concomitant motor innervations. Consequently, our first task in the analysis of the complete process of learning in human beings must be that of arriving at a clear understanding of the factors which are concerned in the production and selection of random forms of movement, in response to particular stimuli.

In our historical review of the study of "trial and error" learning, as well as in our chapter on "instincts," we have seen that random movements appear when an appetition is aroused. The mechanism of the production of these movements cannot be fully explained at this point in our argument. However, certain general causes can be assigned. In the first place, we should certainly expect *some* kind of motor reaction to follow as a consequence of the appetitional currents which are flowing into the cortex, if we assume that it is a general property of the cortex that it tends to generate motor innervations when sensory excitations are received. However, the reaction of the cortex to the appetitional currents is not qualitatively different from that to any sensory impulses. Stimulation of the eyes, ears, or other non-appetitional sense organs, may also be expected to arouse movements. What is called "play" in young animals may be regarded as random activity of this sort, based upon non-appetitional stimulation. If the question is asked as to why the cortical motor innervations are "random" the answer may well be that it is because no systematic connections have yet been formed. The cortex is compelled to supply some sort of movements, and it may have to respond with something which is not pertinent to the given situation. In the preceding chapter, we have considered some of the factors which may actually determine the particular random innervation which appears at any given time. In the last analysis, of course, we cannot relegate the process purely to the domain of chance.

In accordance with this view—which harmonizes very well with that of Woodworth in the given respect—all stimuli act as "drives" to cortical motor innervation. The appetitional nerve currents may be regarded as being particularly powerful in this respect, since they all fall into the class of nociceptive or beneceptive processes which, according to Sherrington, are endowed with especial neural energy. Now, in experiments upon animals and human beings, the phenomena which may be actually observed are somewhat as follows. The animal exhibits a given kind of behavior and may continue this for some time, but soon it is replaced by another kind. This latter, in turn, may run on for some time but finally gives way to still another type. It would seem to be a satisfactory description of what happens here to say that the "trial" movement is *inhibited,* so that it is replaced by a different movement; but if this second "trial" does not lead to satisfaction of the appetition, it, also, is subjected to inhibition. If a particular kind of movement is inhibited, it naturally has a reduced tendency to appear, and in order to account, in a general way, for the elimination of the unsuccessful movements, we have only to suppose that this reduction persists over a long period of time. The only movement which is not inhibited will be the one which satisfies the appetition.

A theory somewhat of this character has been advocated by Hobhouse. He supposes that the movements which do not lead to success bring the animal under the influence of stimuli which set off reactions antagonistic to the original movements. Thus, a pedestrian who is endeavoring to cross the street, sees an automobile and is impelled to retreat; or a cat, in trying to get food inside of a cage, squeezes its nose between the bars, and, thus, receives a stimulus to withdraw. In this manner, the movements in the series of "trials" which are unsuccessful, come into association with opposite movement tendencies and tend to be "neutralized." A similar view has been advocated by Holmes, who characterizes the elimination mechanism by saying that "incongruent" tendencies will disappear from the responses of the animal to the given situation.

Now the "incongruity," which Hobhouse and Holmes regard as being responsible for the elimination of the unsuccessful movements, evidently develops with reference to the "final common path," or motor neurone system, following the ideas of Sherrington. However, learning requires a change in the adjustor mechanisms of the cerebral cortex; and since this adjustor system is a place of contact between the total *afferent* effect, and the total motor control, the influences which bear upon it must have afferent sources. The motor phenomena are merely *expressions* of these influences, not causes of them. Consequently, it would seem to be necessary to look for the real cause of the inhibition in the afferent nerve currents which are set off in the pedestrian when he sees the automobile, rather than in his motor reactions. If a chick picks up an ill-tasting caterpillar and is impelled to disgorge its prey, the inhibitory agency would appear to lie in the nociceptive taste impulses. The first thing which these impulses must accomplish when they arrive at the cortex is to stop the innervations which are carrying through the process of ingestion. Having done this, they can then proceed to set off the disgorging reaction. This agrees with the common sense interpretation of the chick's behavior, according to which the bird stops eating the caterpillar and spits it out because it tastes badly. The attempt to explain the interference in terms of the motor side of the system is evidently due to an unwarrantable behavioristic bias.

The really critical point, however, with regard to the Hobhouse-Holmes type of explanation lies in the necessity that all reactions which are set off in the process of "trial" behavior should be incongruent with the "trial" movements, except when the latter are such as to lead to success. This necessity does not seem to be realized in the facts. Thus, it does not seem to follow inevitably that when an animal does the wrong thing in its quest for food, it will meet a stimulus which will warn it automatically of its error. When a cat presses its nose between the slats of a problem-box, it will not necessarily be impelled to withdraw; such pressure upon the nose and mouth region may cause the animal to push harder, an action which can frequently be noted in petting a cat. It might happen, therefore, that the unfortunate animal would find itself pressed permanently against the slats, because of the appearance of a form of reaction which was congruent rather than being incongruent with the trial response. If we consider an animal running in a maze, we may explain its avoidance of cul-de-sacs on the theories that they are nose-bumping arrangements; but suppose that each cul-de-sac is a wonderfully comfortable place to sleep. This does not prevent the hungry animal from leaving them all behind.

110. *The Inhibitory Mechanism of Appetitions*

In order to arrive at a principle having greater infallibility, we might suppose that *during the course of appetitional stimulation all responses are inhibited which do not bring about release from the appetition within a certain interval of time.* The inhibitory action in this case would have to be assigned to the appetitional process itself. We should be compelled to suppose that the afferent nerve currents of the appetition act, firstly, to arouse motor innervations, but, secondly, to suppress these innervations if they fail to remove the appetitional disturbance. The appetition is apparently called upon to exert two mutually incompatible influences, but this does not involve us in any logical inconsistency if we separate the incidence of the two influences in time. The excitatory effect which arouses any given movement may be regarded as initial and practically instantaneous, whereas the inhibitory action is cumulative, being substantially nil at the first moment of the reaction. This view explains the succession of different reactions which characterize appetitional behavior; each reaction persists until it has finally been reduced to a level of inhibition which permits its nearest rival to replace it. We may suppose that when a given form of response has been set aside in this manner the inhibition gradually wears off, so that the response may reappear at some later time. However, the recovery from the inhibition is never *complete,* and so the given form of innervation has a reduced probability of recurrence.

The principles laid down in the last paragraph imply that all responses, reactions or movements which are aroused while an appetitional process is active, will be repressed permanently, in proportion to their failure to eliminate the appetitional nerve currents. Only the response or reaction which brings about such elimination will be free from this repressive influence. As a matter of fact, even this "successful" reaction will be subject to inhibition, although to a less degree than any of the others; so that when the stimulus is again presented, the "successful," and "final," reaction will be the most likely one. Another way of stating the matter is to say that all reactions which are associated with the presence of the appetition are inhibited, only those which accompany its disappearance remaining unaltered.

It is evident that this view, also, is not free from difficulty; because cases can be found in which the "successful" reaction will be subjected to the influence of the appetitional condition over a period as long as that for other trials in the series. Thus, when the cat succeeds in opening the box which contains the food, it remains hungry throughout this reaction, and even for some time after actually swallowing the food. If we suppose the hunger to be on the increase as the "trials" proceed, the action of the hunger upon the final response will be more intensive than that upon some attempt which is earlier in the series. In order to avoid this difficulty, we are compelled to make the inhibitory action *retroactive,* so that all of the random movements which have been tried continue to be repressed in a cumulative manner even after they have disappeared actively from the scene. In accordance with such a principle, the final or successful movement would be subjected to the repression over the shortest period of time, gaining in this manner a very distinct advantage by being the last in the series.

Another way of avoiding the difficulty would be to assign a positive, reinforcing effect to the processes which are associated with the relief or satisfaction of the appetition. Thus, in the case of hunger, the smell and taste of the food—or possibly, the consummatory deglutition reflexes—might be considered to retroact upon the immediately preceding responses so as to make them more likely to recur in the future. In accordance with this view, the final reaction would be strengthened to the maximal extent by this facilitative action, whereas the unsuccessful ones would be subject to less facilitation and more inhibition. Hence, when the situation again recurred, we should expect the successful movements to reappear more readily than would any of the unsuccessful ones. This differential effect could be small in any single experiment, since it usually takes a considerable number of experiments (or series of trials) to eliminate the useless reactions. We have only to suppose that the differential effect is cumulative over the entire history of such experiments. This view corresponds approximately with what Perrin and Klein [135] call the "drive" or "motor set" theory, which they ascribe to Woodworth, Perry, Tolman and Kuo.

The notion of a retroactive influence of the facilitative and inhibitory effects, which is involved in some of the above theorizing, does not commend itself *a priori.* However, if the processes which we are considering follow the laws that govern the formation of conditioned reflexes, we have an experimental basis for believing in the retroactive principle. We have seen in our review of the experiments upon the conditioned reflex that conditioning can occur even when a period as great as thirty minutes separates the "primary" from the "secondary" stimulus, provided always that the latter precedes the former. In case the secondary or "conditioning" stimulus occurs subsequent to the primary one, there is practically no conditioning. In the applications which we have been considering above, the "secondary" factors are those of the random movements, whereas the "primary" ones are, first, the appetitional nerve currents, and, second, the processes which accompany the removal of the appetition. Hence, we might expect a retroactive influence of the latter. Such an action appears to be a practical necessity in order to insure effective learning, either of the simple conditioning sort, or of the more complex type which we are now endeavoring to explain. If the effects were confined entirely to the given phase of the nervous process, they would fail to establish the relationships which are needed in order to yield biologically valuable results. The mechanism of this retroactive influence must undoubtedly be stated in terms of "traces," residual excitations, or their equivalents.

111. *Cortical Adjustor Conductances*

It will be perceived that the majority of extant theories of the trial and error process of learning suffer from a vagueness which makes it difficult to comprehend them at all clearly. This is evidently due to the lack of appropriate and clearly defined fundamental conceptions. Consequently, before we proceed further it seems advisable to establish some basic ideas of this sort.

In the first place, let us hark back to the conception of response as a form of physical conduction. Every human act, no matter how simple, no matter how involved, can be regarded as an end effect of a conductional process, which follows a circuit or arc, beginning at a sense-organ, passing through one or more centers (adjustors), and terminating in an effector. The behavior effect is a resultant of several factors which determine the conduction. As we have seen, these factors can be regarded as being analogous to those which enter into the familiar Ohm's law, which applies to electrical conduction, and in accordance with which the *current* (corresponding to the behavior effect) is proportional to the *voltage* (electrical pressure) and inversely proportional to the *resistance*. The voltage may be regarded as an external force acting upon the conducting network, whereas the resistance is an inherent property of the latter.

In the case of conduction through a nerve circuit or arc, the voltage factor seems to be a creation of the afferent side of the arc—depending upon the stimulus, the receptors, and the sensory nerves—whereas the resistance is localized primarily in the nerve center,—particularly in the synapses or junction points. For most purposes, we can identify the voltage factor with the stimulus, since the afferent energies are under the control of the latter, and are in substantially constant relation to it. The operation of learning must depend fundamentally upon changes in the resistance factor. Thus, in accordance with the familiar principle of exercise, the passage of nerve currents through synapses reduces the synaptic resistance, so favoring the particular form of conduction which brings about this change.

Now, we have seen that in the case of reflexes, this conduction process is determined primarily by the pattern of anatomical conjunction of the conducting paths, aided by other inherited properties of the nervous material. However, in our discussion of the cortical mechanism, we have observed that the cortex provides a universal network of interconnections between all afferent and all efferent channels, so that the selection of particular lines of conduction through the cortex must depend upon the exact distribution of resistances within this nerve network. Any characteristic form of afferent nerve excitation which impinges upon the cortex finds a very large number of alternative possible efferent "ways-out," representing so many different specific responses to the given stimulus. In choosing among these alternatives, the nerve current will necessarily follow the path of least resistance. Owing to the principles of the "threshold" and "all or none," the lowest resistance path may be expected to absorb all of the afferent disturbance, the other alternative channels remaining entirely quiescent.

If we follow this line of thinking, the theory of learning must be reduced to an understanding of the means by which cortical synaptic resistances can be altered. We may regard the process of "trial and error" learning as involving a competition between numerous paths of conduction, during which competition the resistance ratios of these paths must be altered if any learning effect is to be produced. One path may become dominant over others either (1) because all of the others are increased in resistance, or (2) because the others remain unchanged and the particular one acquires a reduced resistance, or (3) these two effects may be combined. It will probably be an advantage in the majority of contexts to use the term *conductance* instead of "resistance," since conductance must be conceived as being proportional to the tendency of the synapses or other nerve elements to conduct, whereas resistance has the inverse relation. The higher the conductance of a nerve path, the more likely it is to function.

112. *Properties of Cortical Response Arcs*

In order that we should reason properly with regard to the competition of alternative cortical response arcs, we must constantly bear in mind several of their outstanding properties. In the first place, these arcs cannot operate unless they are provided with the right kind of a stimulus. The conductance of a particular path may be extremely high, but it can obviously play no part in the regulation of behavior unless the appropriate environmental, or intraorganic force, appears to energize it. In the case of cortically regulated response, the requisite stimuli are often highly specific, necessitating an accurate reduplication of particular patterns of stimulus energy. Thus, we cannot play golf unless we are provided with the stimuli which go with golf-balls, clubs and other paraphernalia of this sport; regardless of how conductive our "golf arcs" may be. Neither can we indulge in the cigarette habit without cigarettes and matches. The difficulty in these cases is primarily sensory rather than motor, since, theoretically, we could go through the motions—although somewhat imperfectly owing to the absence of the accustomed proprioceptive or tactual control—but, actually, we never do this except when we have a secondary stimulus and form of response, such as that to "stage" some comedy. It will be seen, therefore, that a knowledge of the relative conductances of various alternative lines of nerve current transfer through the cortex does not by itself permit us to predict what an individual will do. It only enables us to do this when the stimulus situation is specified. This is, of course, merely a corollary of the fact that response is meaningless without a stimulus, and learning involves the determination of what reaction will follow when the stimulus is given.

Another point, which we shall do well to bear in mind, is that the cortical conductances which are involved in learned response must have an extremely complicated foundation. The conditions and relationships which are concerned are by no means identical with those of a simple diagram of alternative, separate lines of conduction; as represented, say, by a single incoming nerve fibre, which may discharge into any one out of a group of alternative efferent fibres. We have seen that the majority of cortically controlled reactions involve the entire voluntary musculature, whereas the stimulus patterns usually implicate all of the sensory receptive surfaces. Consequently, the conductance relationship must exist between a very complicated, specific afferent pattern of excitation and an almost equally complex efferent system. However, it is not necessary for us to understand exactly how this form of interconnection is carried out physically. We are justified by the observed facts in believing that any given afferent pattern can have a quantitatively specific connection with particular efferent patterns, so that it finds the latter to be accessible in definite degrees. Hence, we can think about the situation by analogy with individual unit conduction paths, but we must remember that the actual units are excitation patterns. The individual paths are used over and over by patterns of all kinds.

113. *Physiological Interpretation of the "Law of Effect"*

In terms of the above analysis, the behavior of an animal when it is faced with a problem-box or a maze, seems to demand the following interpretation. The cortical conductances for specific responses which fail to satisfy the appetition are permanently or semi-permanently reduced, relatively to the conductance of the "successful" response —which is instrumental to such satisfaction. This decrease in conductance is the equivalent of inhibition. Without further evidence, we cannot determine whether the change in the relative conductances for the unsuccessful and the successful response is due purely to inhibition of the former, or whether it also involves facilitation—or conductance increase—of the latter. We can feel certain that the unsuccessful responses are inhibited, since they are discontinued in the course of the experiment. The mere fact that they fail to reappear in subsequent experiments would not necessarily prove that they had been inhibited, since they might drop out merely because of the increased superiority of their rivals.

Our next problem would seem to be that of arriving at a clearer notion of the mechanism of such inhibition or facilitation. In discussing this matter, we may define inhibition as a process of lowering the conductance of nerve paths—presumably at the synapses or, at any rate, in the adjustor stage—whereas facilitation may be defined as an increasing of such conductance.

We have already suggested above that one of the principal defects of recent attempts to explain trial and error learning lies in the behavioristic bias, which leads the theorist to look for the essential conditions on the efferent side of the arc. We have seen that if the conductance changes are to occur in the cortex, they must be engineered by afferent rather than by efferent devices, since there is no "backfire" of the efferent system into the cortex. It is true, of course, that there are proprioceptive impulses which represent the efferent activities, but these impulses are just as afferent as any other components of the sensory excitation. It is also true, of course, that the afferent mechanisms have been set up by heredity so as to minister to the demands of the efferent side of the response arc. Concerning this there can be little doubt, but the question as to the genesis of the mechanism has nothing to do with that as to its present mode of operation. An exclusively genetic explanation cannot be regarded as satisfactory.

Now, if we are permitted to ascribe the inhibitory and facilitative operations to mechanisms lying on the afferent side of the arc, we can hope for some suggestions from the much maligned "pleasure-pain" theory, as represented, for example, by the earlier doctrines of Thorndike. Modern psychologists seem to have a particular aversion to any kind of common sense view, and particularly to the idea that pleasure and displeasure have anything to do with motivation. It would seem, however, to be a problem for the psychologist to solve as to why it is that all psychologically unenlightened individuals regard pleasure and displeasure as the key to the whole motivational scheme. A study of most of the arguments which have been advanced against the pleasure-displeasure theory will show that they are exceptionally puerile, in that they disregard not only the facts of common sense observation, but some of the best established scientific principles of non-common-sense psychology. It is certainly absurd for any modern psychologist to reject the hedonistic doctrine on the ground that we cannot understand how a mental phenomenon, such as pleasure, can act upon a nerve process. Inexplicabilities of this sort have been brushed aside as a class by the doctrine of psychophysical parallelism, and although they may continue to exist they do not prevent us from believing that fixed relationships actually do exist between mental and physiological factors.

Of course, we might begin by censuring Thorndike for stating his "law of effect" in psychological terms, so that it seems to be a "law of affect." Even when he passes from pleasure to "satisfyingness" and from displeasure to "annoyingness," the implications remain essentially psychological. However, it is surely not very difficult to reinterpret these terms in purely physiological form, by picking out the physiological processes which are correlated with the pleasant and unpleasant mental states, respectively. After having done this, if we actually feel no interest whatsoever in the mental side of the situation, we can forget entirely about the psychological facts and pay attention only to the corresponding physiological ones. Now, if psychologists find themselves unable to make such a translation on the basis of their own observations, they can consult the physiologist for a clue. It will be recalled that Sherrington has observed a connection between strong affectivity and certain types of reflex excitation, which are set off by what he calls *nociceptive* and *pseudaffective* stimuli. We have amplified his terminology by introducing the term, *beneceptive,* as the complementary adjective to "nociceptive."

Even if we were not blessed with the guidance of Sherrington, we might glean some suggestions from common sense observation. To quote from Perrin and Klein:[136] "Ask a mother why she slaps little George for stealing a cookie, and she will reply that the sting produced by the slap is unpleasant; and consequently, if on a subsequent occasion George is tempted to repeat his disobedience, the memory of the unpleasantness will cause him to refrain. In a similar fashion, she will defend her course of action in whipping the family dog for "snapping at the baby." According to Perrin and Klein: "Such a theory is essentially sound as a *description* of the facts, but a careful analysis will show that it is not an *explanation*. It does not tell us *how* pleasure as such and pain as such bring about their alleged effects." It would, however, seem easy to make a guess as to the "how" of this process. All that we have to assume is that the stimulation of nociceptive afferent channels reduces the conductances of the paths of cortical conduction which are operative at the moment, or have been operative over a limited prior interval; and that, on the other hand, the excitation of beneceptive channels will cause a corresponding increase in conductances. This hypothesis is very simple and involves no reference to the conscious phenomena. We shall find that, in conjunction with other well-established principles, it is adequate to explain most of the puzzles of trial and error learning. We have only to ascertain what afferent channels are nociceptive and what ones are beneceptive, respectively.

Chapter XII

Nociception, Beneception and Retroflex Action

We may be tempted to define a nociceptive sense channel as one, the normal excitation of which produces unpleasantness in consciousness; whereas a beneceptive channel could be specified with reference to the pleasantness which normally accompanies its operation. But such a method of classification would lay us open to the charge of employing a psychological criterion. While this charge does not seem to be unduly serious, nevertheless, it is advisable to avoid the use of a mental distinction, first, because this kind of distinction is not necessary and, second, because it would logically prevent us from establishing a significant correlation between the physiological and the psychological processes at a later point in our argument. In the latter regard, if we pick out nociceptors and beneceptors by a purely biological criterion and then show that their functions have a constant correlation with the affective life, this conclusion will not be a mere logical construction, but will have real empirical significance.

The criterion which we must actually adopt in classifying the various receptive systems as nociceptive, beneceptive, and otherwise, must apparently be of a general biological nature, depending upon the relationship between the given receptive process and the welfare of the species. By welfare, we merely mean the best chances of *survival,* referring not at all to such concepts as progress or happiness. On this basis, we may define a nociceptive system as one which responds specifically to stimuli that are injurious to the organism or the species, whereas a beneceptive system may be characterized as one which is especially sensitive to beneficial stimuli. It is understood, of course, that the use of the word, "stimuli," in this definition is sufficiently broad so that it is not restricted to the exact force which excites the receptor, but applies, also, to the usual accompaniments or conditions of this force. Thus, the stimulus to the nociceptive pain system may not in itself be injurious to the pain nerve ends, but it is the normal outcome of conditions which tend to destroy the adjoining tissues, or to interfere with their natural metabolism. Moreover, the definition of a nociceptor or a beneceptor will probably be found to be strictly applicable only to *average* biological values. In particular cases, we may find that a nociceptive mechanism is set off by conditions which are actually beneficial to the individual, or *vice versa* a beneceptive process may be aroused by actually injurious circumstances. This is merely due to the fact that evolution cannot develop a device which will be infallible under all conditions; and, since this is a general weakness of the evolutionary process, it cannot be considered to vitiate our definition. Thus, the beneceptive system which is set off by the presence of the invaluable sugary food substances in the mouth, can also be excited by acetate of lead, which is a deadly poison. If evolution had been compelled on the average to deal with acetate of lead rather than with carbohydrate materials, the saccharoceptive process would have to be classed as nociceptive rather than as beneceptive.

114. *Catalogue of Nociceptive Systems*

If we review the various departments of sensation or reception, we find it quite easy to group the mechanisms into the three classes: nociceptive, beneceptive, and (let us say) neutroceptive. The principal representatives of the latter class are vision, audition, and touch. The latter includes the pure pressure sensibility of the skin, excluding the cutaneous pain and temperature responses. We can also probably include in the neutroceptive class the operations of the true proprioceptive system, excluding the pain and fatigue factors. This leaves us essentially with the joint surface sensibility. Certain aspects of the equilibrium sense of the inner ear are also probably to be regarded as neutroceptive. When we classify these receptive systems in this way, we cannot mean, of course, that they fail to respond in a specific manner to beneficial and injurious stimuli. We merely observe that their response is not particularly, or exclusively, attuned to such conditions. Vision picks up the picture of a sweetheart, or of a ferocious animal, with equal facility, and it also records equally well a perfectly meaningless pattern, such as a seismograph record. We are here referring, of course, to the innate peculiarities of the apparatus, and not to results which may accrue from learning.

The principal nociceptive system is evidently that of pain, this being identifiable not only by its psychological correlations, but by a number of anatomical and physiological criteria. Thus, in the case of cutaneous pain, the system begins with the so-called free nerve endings in the skin, and is characterized in the spinal cord by conduction along a certain segregated bundle of fibres; and in the thalamus by organization about a particular adjustor nucleus. In the present state of our knowledge and terminology, it may be necessary to identify certain sensory systems by reference to their "effects" in consciousness, but this would not require a definition of the systems in question in terms of these effects. Thus, we may not be able to identify the particular nerves, the operation of which is responsible for the sensation of hunger, but we can class these nerves as nociceptors, without any reference to the nature of their psychological accompaniments, the latter merely serving to identify them. Using this method, we may say that any receptive system, the arousal of which is accompanied by what we call pain in consciousness, may be regarded as nociceptive, provided it can in fact be shown that the system in question is reactive to an unhealthy state of the tissues in which its receptors are embedded.

It will be perceived that the majority of the sensory devices which we have regarded as bases for *appetitions* fall into the nociceptive class. Thus, not only pain excitation but the stimuli to the appetitions of hunger, for relief from excessive heat or cold, for air, for water, to micturate, to defecate, etc., represent conditions which are detrimental to the existence of the organism and species. An empty stomach, empty lungs, or a full bladder, or large intestine, are biologically threatening conditions. The same considerations apply to low water content of the tissues, or to continued warming or cooling of the body, with respect to the normal physiological temperature.

The major appetitions do not, however, exhaust the possible list of nociceptors. We must include a considerable number of specific receptive processes which are set off in conjunction with the alimentary function, some of which we have already discussed as minor appetitional sources. Thus, the four classical taste responses provide us with at least three which may have a nociceptive character. That of "bitter," corresponding to the presence of poisonous, alkaloid material in the mouth, is certainly nociceptive in significance. In the cases of "salt" and "sour" the processes may be regarded as being nociceptive if they are of high intensity. We cannot avoid the principle that the degree of the action has a bearing upon whether or not it is injurious. Although low concentrations of acid or salt may be harmless, or even beneficial to the organism, it is easily possible to ingest an excess of these substances. The same thing can be said even in the case of sugar, at a very high concentration, or total amount taken in.

The olfactory receptive processes also include nociceptive sensibilities, although we are unable to identify these separate functions upon a purely physiological basis. The classifictions of the olfactory responses which are usually given require a psychological criterion, although they refer also to certain groups of characteristic stimuli. In Zwaardemaker's [137] classification of odors, the following must be regarded as having nociceptive significance: (1) the alliaceous (corresponding to substances like hydrogen sulphide, chlorine, etc.), (2) the caprillic (corresponding to urine, sweat, etc.), (3) the repugnant (corresponding to the odors of certain insects) and (4) the nauseating (represented by decayed flesh, feces, etc.). All of the indicated substances are poisonous or unhealthy, and the appetitional responses which they evoke seem to be directed towards their avoidance. The sensory impulses corresponding to nausea must also be classed in the nociceptive group, since the normal arousal of these impulses accompanies the presence in the stomach of substances which are unfit for assimilation. Still further nociceptive channels can probably be specified, but the above summary will suffice for our present purposes.

115. *Catalogue of Beneceptive Systems*

The next problem is that of specifying the beneceptors or beneceptive systems. The most discussed, and probably the most powerful of these is that of erotic excitation. We have regarded this afferent process as providing the foundation of the sex appetition, and consequently, we are compelled to state that appetitions are not necessarily founded upon nociceptive stimulation. It is likely, however, that their basis is always either nociceptive or beneceptive. The majority of the appetitions appear to be of a defensive type, directed towards the removal of injurious conditions. The sex instinct is unique in that it does not work for the alleviation of a condition which is injurious to the individual, and in fact is of no biological advantage to him whatsoever. It is also seemingly unique in that the unrest appears to be generated by a beneceptive rather than by a nociceptive action. Of course, we may argue that erotic excitation is not a benefit, and may be a detriment to the species if it occurs without copulatory contact between the sexes; so that the process might be regarded as being nociceptive until this relationship is secured. We shall consider this problem again at a later point in this chapter, where we shall see that the simplest assumption is probably to regard the afferent processes of the tumescent, but low intensity erotic state as nociceptive; whereas the higher intensities of the erotic process fall clearly into the beneceptive category.

Next in importance to erotic excitation among beneceptive processes is the gustatory response to sugars. This *saccharoceptive* system has, as its function, the detection of carbohydrate substances which, when ingested by the organism, provide it with the essential fuel for muscular action. The presence of such substances in the mouth must obviously be regarded as beneficial to the organism and species. The olfactory sense, also, includes a number of beneceptive reactions, although as in the case of nociceptive olfactory responses, it is impossible to identify them anatomically. In terms of the distinctions of the Zwaardemaker classification, they are as follows: ethereal odors (corresponding to fruit essences, alcohols, etc.); aromatic odors (corresponding to spices, camphor, etc.); and balsamic odors (corresponding to flower perfumes). These three classes of odors are indicative of the presence of fresh vegetable products which are frequently beneficial as food, or are associated with such food. It is well known that the olfactory sense operates not merely by the ordinary mechanism of smell, through the anterior nares, but in close association with taste, through the posterior nares. Thus, the olfactory sense applies to substances within the mouth, as well as to those which may be before the nose. It is to be hoped that our classification of odors with respect to their biological significance will be greatly improved in the future. The sense is a difficult one to deal with from the purely physiological standpoint, but we cannot doubt that it furnishes the nervous system with important criteria for determining the suitability, for ingestion, of substances which may be taken into the mouth.

It is possible that there are some further definitely beneceptive afferent mechanisms which are associated with the alimentary process. The sensations which accompany the presence of good food in the stomach suggest that the normal digestive activity of this organ gives rise to afferent nerve currents, and these would undoubtedly have to be regarded as beneceptive, since they are a consequence of beneficial processes of digestion. However, an excess of food in the stomach would be mechanically injurious (affecting breathing and heart action) and hence give rise to nociceptive impulses. We must also note here a necessary complication of our analysis, which depends upon the fact that a single sensory mechanism may sometimes act as a beneceptor and at other times as a nociceptor. This applies to the gustatory senses for "salt" and "sour." Low concentrations of acid and salt are positively beneficial to the organism. In the case of salt they are absolutely essential. Since the salt receptors are sensitive to concentrations of this low order of magnitude, we are compelled to say that the low intensity responses of this receptive system are beneceptive, whereas the higher intensity ones are nociceptive. The same proposition can be applied to the "sour" sensibility. In the case of "bitter," it is also possible that the low intensity response should be regarded as beneceptive; and that in the case of the saccharoceptive system, extremely high intensities of excitation are properly considered to be nociceptive.

A similar complication has been noted in the case of the temperature senses of the skin. The low intensity excitation of the "warmth" receptors may be regarded as beneceptive, since these receptors are normally aroused at temperatures which are lower than that of the blood. This low intensity arousal does not indicate any definite threat against the temperature equilibrium of the body; in fact, it may indicate forces which will assist in the maintenance of this equilibrium. However, after a certain critical temperature has been passed, the warmth excitations must be regarded as being nociceptive. In the case of the response to "coolness," the process is nociceptive at any level, except when it is subsequent to excessive exposure to heat, in which case it is indicative of a beneficial cooling action. Here we obviously have the further complication of a time or adaptation factor: the coolness will be beneficial—and hence the receptive process will be beneceptive—until such time as the proper temperature balance has been restored, after which the continued exposure to cold becomes injurious, and the temperature reception must be regarded as nociceptive.

116. *Nociception and Beneception in General*

Observations such as these may well lead us to define processes of *nociception* and *beneception,* which are not necessarily dependent upon particular nociceptors or beneceptors, respectively. A given afferent system may be nociceptive under one set of conditions and beneceptive under another. Under still different circumstances, it may be neutroceptive. However, we should always be able to specify the laws which govern such cases. Among these laws we must obviously include those which cause beneception-nociception to become functions of the intensities of the stimulus or of the afferent nerve current, or of the duration of these processes. We may also contemplate the possibility that changes in the organic environment of the receptors may be responsible for a shift from noci- to beneception, or *vice versa,* in a single nerve channel. What is good for the organism under one condition may be bad for it under another, these conditions being regarded as intra-organic, in the particular application which we are considering.

Other beneceptive afferent nerve currents may be sought in the processes which follow release from certain of the nociceptive appetitions. We are able to identify these processes only by means of the sensations which accompany them in consciousness, but judging by this test, there are specific afferent excitations which follow from the completion of the acts of defecation and micturition. Since the conditions which result from the successful execution of these acts are beneficial to the organism, the concomitant afferent processes may properly be classified as beneceptive in character. Relief from pain—and particularly from the discomfort which goes with prolonged muscular effort—seems to give rise to "relaxation" nerve currents which are something more than the mere removal of the discomfort excitations.

We may, perhaps, even entertain the proposition that changes or rates of change in noci- or beneceptive afferent currents have a sort of second order noci- or beneceptive significance. Thus the decrease of a nociceptive process would be beneceptive and its increase doubly nociceptive. Similarly, the augmentation of a beneceptive process might be regarded as doubly beneceptive while its reduction would be nociceptive. It is good for the organism to have bad things removed, and bad for it to be deprived of good conditions. If the organism is taking in carbohydrate food, and if it consumes all of the available food before it has filled its stomach, the decrement of the saccharoceptive excitation which ensues when eating ceases, is relatively nociceptive, compared with a continuation of the feeding. However, if the feeding ceases because of a full stomach, then the decrement in question might be regarded as being indifferent, or possibly beneceptive. Similarly, in the case of erotic excitation, a decrease of the excitation prior to the setting off of the consummatory reflexes is detrimental to the welfare of the species, and hence might be viewed as nociceptive; but the decrement which occurs subsequently to the execution of the consummatory processes has an indifferent aspect. In regard to these "second order" aspects, each case will evidently need to be considered on its own individual merits.

It will be perceived that the noci- and beneceptive sense channels which have been designated in the above discussion are primarily concerned with forces or conditions acting either within the organism or very close to its surface. The neutroceptors, on the other hand, tend to deal with objects or conditions at a distance. This distinction is not entirely clear-cut, since the sense of smell is usually regarded as being "distance receptive," whereas the cutaneous and articular pressure sensibilities refer to changes either within the organism or upon its surface. Nevertheless, the predominating function of the noci- and beneceptors seems to be that of making a report to the cortex concerning the metabolic condition of the organism itself, rather than concerning the nature of the environment. In the case of the senses of smell, and taste, this report is anticipatory and deals only in probabilities. The cutaneous and articular tactual senses, on the other hand, have to do with mechanical alterations in the form of the body or its surfaces, which are not directly interpretable in terms of metabolic equilibrium. Thus, the neutroceptors may be regarded generally as recording the environment, and the relation of the organism thereto; whereas the noci- and beneceptors transmit to the cortex constant reports concerning the effect of these factors upon the welfare of the individual or species.

117. *The Nature of "Retroflex Action"*

We must now consider more in detail how the cortex can be assisted by such "welfare reports." If they are to be of any biological value, they must help in removing the organism from environmental relationships which are detrimental, and in establishing or maintaining such relationships as are beneficial. Now, thus far, we have intended our classification of receptive mechanisms—as nociceptive, beneceptive or neutroceptive, respectively—to be of a purely formal biological character. In other words, we have laid down no physiological criterion which would enable us to detect a nociceptive or a beneceptive system by a mere examination of the neural mechanisms. Their definition has been formulated in terms of the status of given nerve channels or activities with respect to the total biological situation. However, we have already stated the principle that the action of nociceptors upon the nervous system is such as to *inhibit* cortical processes, whereas that of beneceptors has a *facilitative* effect upon what the cortex is doing.

We may now generalize this proposition in the following way. *Nociception is accompanied by a decreasing of the conductances of operating cortical adjustors; whereas beneception is accompanied by an increasing of the conductance of operating cortical adjustors.* We may assign to the process which is thus described the general name: *retroflex ac-*

tion. This term is selected because the action in question is a kind of "back-kick" of organic effects into the cortex. The cortex, by its principle of trial and error or random activity, initiates a certain line of response. This, in turn, produces certain actual or incipient organic changes which are reported back to the cortex via the beneceptive or nociceptive channels, and the excitations of these channels modify the cortical tendency. If the "report" is beneceptive or favorable, the tendency in question is enhanced, whereas if it is nociceptive or unfavorable, the tendency is reduced. These actions can be regarded as being determined quite mechanistically, without reference to any accompanying pleasantness or unpleasantness, or any "intelligence" on the part of the cortical process. Facilitative retroflex action, based upon beneception, may be characterized as *positive* because it increases the given cortical conductance; while the nociceptive consequences may be characterized as *negative*.

As examples of these two processes, we may consider the familiar cases of the "burned child," and the child with candy. In the first case we may suppose the child to be indulging in the form of random response which is known as "play." One of the objects to which it responds is a candle-flame, and the reaction happens to consist in placing a finger in the flame. As a consequence, the pain nerves are violently stimulated, and the cortical adjustor process which is associating the afferent flame-pattern nerve current with the outward thrust of the finger, is abruptly reduced in conductance. The consequence of this, in turn, is that the flame-pattern currents cease to pass through this particular junction, and pick out the next most conductive path, which will probably set off a sufficiently different reaction to liberate the finger from the singeing effect of the flame. If it should happen that the next most conducting adjustor does not bring about a sufficient change of posture, this adjustor will also be reduced in conductance in the same manner, the process continuing in this way until an escape is effected. Along with these changes in the cortically controlled reactions there will also be a complex group of reflex responses, which may in themselves assist in the withdrawal of the finger. The sympathetic nervous system will be aroused, the child will cry, etc.

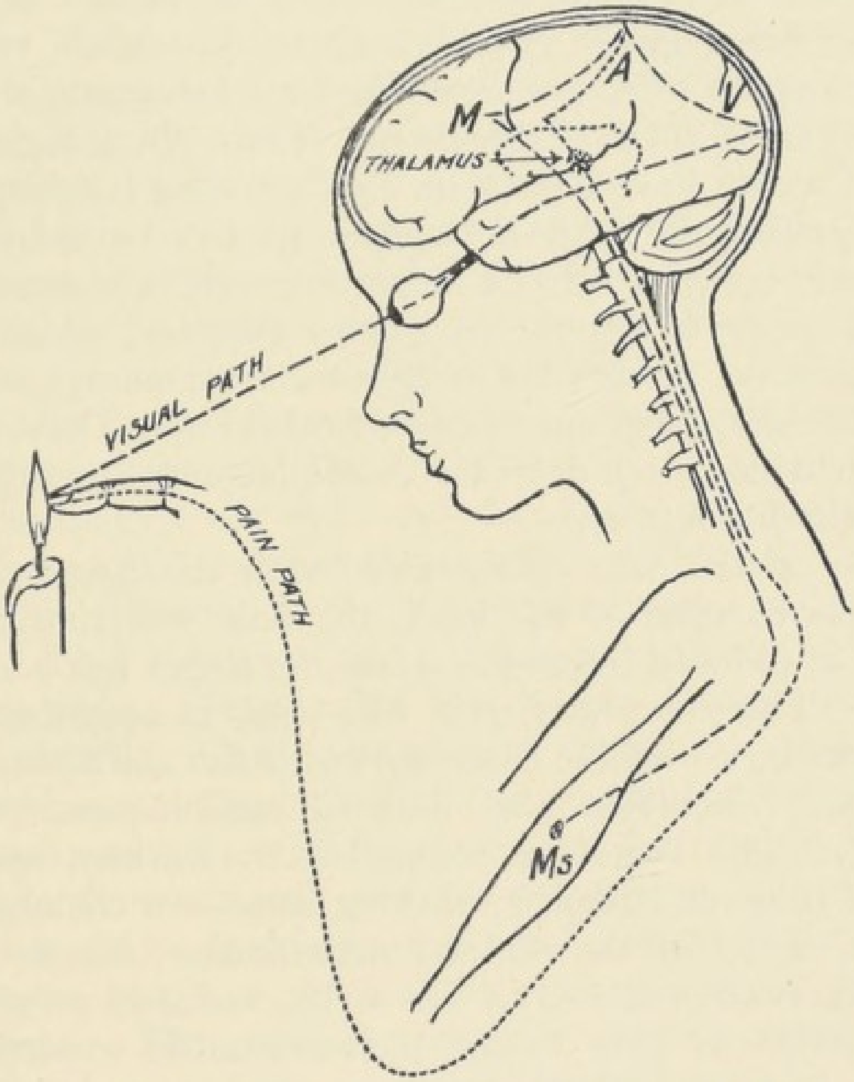

FIG. 2. DIAGRAM OF THE PROCESS OF RETROFLEX ACTION.

A random response to the candle-flame starts along the visual path, to the visual projection area, *V*, and thence to the association region, *A*. From *A* its course is to the motor projection area, *M*, and then to the muscles along the pyramidal neurones. The resulting thrust of the finger into the flame brings about the stimulation of pain nerves in the skin, which sets up a current in the pain path. This current passes through the pain center in the thalamus, thence to the somaesthetic area of the cortex and to the association region, *A*. When it arrives at the latter point it interferes with the original response process, by decreasing the corresponding conductances.

Now, the important point about this process, so far as learning is concerned, lies not in the immediate effect of the nociceptive excitation upon the cortically controlled behavior, but in the fact that a *permanent alteration* has been made in the tendencies of cortical adjustment. The flame-finger-thrust adjustor has had its conductance decreased, and, hence, is permanently less liable to recur. The next time the flame image is presented to the child's eyes, this particular path of response will be found sluggish, and some other reaction will probably occur. Thus, physiological nociception, as we have defined it, has a lasting learning effect. In some cases, the original response tendency may have been sufficiently strong so that a single nociceptive operation will be inadequate to put the particular adjustor, which is concerned, out of action; but it follows from our general formula that successive operations of this kind will have a cumulative influence, each decrease of conductance starting where the other one left off.

Now in the case of the child with the flame, if there is serious burning of the flesh, the pain will continue—although in reduced intensity—after the finger has been withdrawn. This continuing pain will tend, in accordance with our formula, to inhibit anything which the child may voluntarily do. Therefore, the child will exhibit persistent restlessness. The cortex is compelled by its own nature to respond to given stimuli by making some sort of adjustment or innervation of the skeletal musculature; but no matter what innervation it essays, this is blocked and another one supervenes,—as long as the pain excitation continues. It would appear that the restlessness which accompanies nociceptive appetitions can be explained in this manner, without having recourse to any other special mechanism. The child will learn not only to avoid movements and postures which result in finger-in-the-flame, but will develop a reduced tendency to perform any of the voluntary acts which have accompanied the persisting pain excitation. In particular, it will avoid movements which bring pressure to bear upon the injured tissues, because this re-excites intense pain currents, until the member is healed.

However, it does not of necessity follow that all of these changes in cortical conductance will be absolutely permanent. This will depend upon whether later influences appear which may possibly reverse the given conductance changes. There will probably be no occasion for this to happen in regard to the thrusting of the finger into the flame, but the reactions or alterations in conductance which protect the member from further pain excitation, while it is healing, may have to be undone in the interests of preserving the utility of the member in question. Thus, while the finger is sore, the child may be restrained from using it to place candy in the mouth, but when the soreness has disappeared, the facilitative action of the candy may very well overcome the persisting inhibitory condition. Thus, the inhibitory effect is not irreversible, but merely remains unless something actually operates to reverse it.

In the case of the child and the candy, we may suppose him to respond by a movement which places the candy in his mouth. Thereupon the beneceptive sugar excitation is set off. This increases the conductance of the operative adjustor, which is responsible for the presence of the candy in the mouth. Consequently the candy remains, or is swallowed as a consequence of the deglutition reflex which is aroused; and thereafter, the child shows a greatly increased tendency to seek and eat sweetmeats. In this case there is positive learning, or a real enhancement of the conductance of given nerve paths over and above the original values. The enhancement will also be greater than would be effected by the mere principle of exercise. In the case of beneception, there is no occasion for "unrest." The behavior of the individual under these circumstances should consist in a repetition of the movements, or a maintenance of the postures which bring about the beneceptive process.

118. *Variations in Retroflex Action*

A difficulty appears to be presented here in explaining the unrest which we have assumed to accompany all appetitions, when we realize that some of them seem to be based upon beneceptive afferent currents. The outstanding case here is that of erotic appetition. It would appear that any form of response which is going on contemporaneously with erotic excitement should be facilitated. A study of erotic behavior will show that this requirement is satisfied to a very large extent. Any form of reaction which results in stimulation of the erotic center will be continued and in general will be replaced only by some other reaction which is even more effective in this respect. Such stimulation—due to its cumulative effect—eventually brings about the consummatory reflexes and detumescence, thus eliminating the appetitional excitement. The greatest degree of facilitation—or conductance increase—is to be expected at the moment of the orgasm, although in some cases the erotic excitement may actually be greater in some of the preparatory phases. The fact that the consummatory reflexes put an end to the process, and are quickly followed by a reduction of the facilitative action, may lead to the establishment of habits of dalliance.

In the early stages of erotic excitement, however, when the erotic center is under relatively low tension, unrest and random movement may be observed. In order to explain this form of behavior, we may have recourse to several alternative assumptions. First, we might suppose that a low state of excitation of the erotic system is nociceptive in character, producing a decrease of the cortical conductances rather than the reverse. Second, we might assume that there is a specific unrest mechanism associated with the sexual instinct, which operates up to a certain point in opposition to the facilitative principle. Third, we might attribute the unrest to the general "play" tendency of the cortex, which will persist against a background of facilitation until the latter becomes too intensive. The second hypothesis is the least satisfactory of the three. The third must necessarily be accepted in some degree. The first hypothesis appears to be the most effective one in accounting for all of the facts. If we accept it, we must say that a low degree of excitation of the erotic center is accompanied by a reducing of cortical conductances, which passes over into a powerful action of the opposite sort after a higher intensity has been attained.

119. *The Thalamus as a Retroflex Control Center*

Such a reversal of the retroflex process as a function of intensity must also be assumed in the case of certain gustatory processes, although the change is in the opposite direction. In the erotic instance, the nociceptive phase may be regarded as corresponding to a condition of tumescence, without contact stimuli which are adequate to raise the tension of the erotic center above a low level. The existence of both bene- and nociception in conjunction with a single afferent system practically necessitates the assumption of a special central mechanism which can control the polarity of the conductance change as a function of the intensity of the afferent nerve process. Our present knowledge of the cerebral arrangements does not enable us to arrive at any very secure notion concerning the location and exact character of this mechanism. However, there is considerable plausibility in the suggestion that the retroflex activities are exercised through the medium of a subcortical center located in the thalamus.

The investigations of Head and Holmes [138] provide us with plenty of evidence that the thalamus exerts a powerful influence upon cortical processes of the so-called "affective" type. We may suppose that the thalamic "affective" centers are able to facilitate or to inhibit any cortical activity which may be going on, by means of special nervous interconnections. Herrick [138a] points out that the premotor cortex of the frontal lobes of the cerebrum is in particularly intimate relationship with the thalamus; this porion of the cortex being concerned with the organization of voluntary motor innervations. He approves the view of Tilney and Riley [138b] that this linkage may permit the affective energies of the thalamus to motivate the incito-motor processes of the cortex. The relation between the thalamic energies and those of the cortex in this respect may be conceived to be similar to that between two reflex unit mechanisms, which, as we have seen, may either facilitate or inhibit each other. Of course, the process will probably be much more intricate than in the case of simple reflexes, and its details can only be conjectured. If there were a sufficient wealth of nerve connections, we might suppose that the thalamic center has a double set of fibres leading to all points in the association surfaces of the cortex. One set of fibres could have synaptic endings such as to produce a facilitative effect, whereas others could be equipped with inhibitory endings.

Since the anatomical requirements of such a scheme are perhaps unduly involved, we may be compelled to believe that the thalamus acts upon the cortex by means of some principle of differential chronaxy. In accordance with this idea, it might utilize one rhythm of impulses, which could spread throughout the cortex along the ordinary paths of interconnection, to produce a depressive influence; whereas a different rhythm might be responsible for the opposite effect. The general principles of nerve physiology suggest that low frequency discharges should prove to be facilitative, while very high frequency nerve currents should have an inhibitory effect. It is probable that the paths along which the thalamus acts upon the cortex are really the same as those which carry the sensory impulses themselves thereto. All of these impulses—with the exception of the olfactory—pass through the thalamus on their way to the cortex. The thalamus is a sort of vestibule for the cerebrum. Even the olfactory afferent system has very elaborate connections with the thalamic region, particularly to the so-called epi- and hypo-thalami.

Another possible hypothesis, to explain the thalamic action upon the cortex, lies in the supposition that the thalamic centers may control the liberation of two different kinds of hormones, which can enter the blood-stream, and have specific chemical effects upon the cortical adjustors. The latter might be specifically sensitive to such substances, just as the muscles and the liver cells are to adrenin; or the pancreas to secretin. It is worthy of note in connection with this idea that there are a number of so-called glands attached to the brain in the thalamic region.[139] One of these, the pituitary body, has been shown to give off endocrine substances which are of great importance in maintaining organic equilibrium. It is interesting that the pituitary has a bipartite structure, and an apparently double endocrine function. The famous pineal gland, which Descartes regarded as the seat of the soul, is also attached to the brain in the thalamic region. This is generally supposed to be a vestigial eye, but Berman and others have attributed to it an endocrine function. The endocrine explanation of retroflex action is tempting in that it provides a method whereby all parts of the cortex can be influenced simultaneously in a very simple manner, without special nerve connections. Furthermore, we should expect such an influence to differ in kind from that of ordinary nerve excitation, perhaps producing more permanent modifications of the neural tissues. The principal difficulty with the general idea seems to lie in the possibly too great slowness of the endocrine process, to explain the actual time relations of the retroflex mechanism.

It will be noted that, in general, the thalamic or retroflex action upon the cortex must be supposed to affect those adjustors which are operative at the given moment, leaving the others unmodified. Herrick [139a] notes "that cerebral regions at the moment under excitation are physiologically dominant over unexcited parts and that the efficiency of this dominance is dependent in part upon the intensity of the excitation and in part upon the conductivity of the intervening lines of transmission." However, in order to explain actual learning phenomena we must also assume that adjustor patterns which have been functioning during a certain period prior to the retroflex excitement will also be influenced in the characteristic manner. We have already seen that such a supposition is in harmony with empirical findings with regard to the formation of conditioned reflexes. We may imagine that an adjustor which has been in use—even if at the given moment it has been displaced functionally by another—nevertheless continues to be susceptible to the action of noci- and beneceptive nerve processes. This susceptibility, however, must decrease as time goes on, and may be considered to be at its maximum while the adjustor is actually functioning. Thus, we may expect the learning process to be retroactive to some extent, but to become feebler in proportion as the time between active use of the adjustor and the excitation of the retroflex process increases. On the other hand, if we follow the principles which have been demonstrated in the case of conditioned reflexes, we should not expect adjustors, which come into operation subsequently to the cessation of a retroflex excitation, to be influenced by the latter.

120. *Other Aspects of Retroflex Action*

It should be observed that the principle of retroflex action rests upon purely temporal and not upon actually causal, relationships between the given cortical adjustment and the effect which is exerted upon it. Thus, the inhibition or facilitation will not necessarily pick out the correct adjustor in all cases. If we suffer pain because of some act which is long since past, there will be no direct inhibition or reduction in the tendency for this act to recur. The inhibitory influence will be felt only by the responses which happen to be going on when the pain process appears, or which have preceded it by a comparatively short period of time. These considerations account for many unfortunate failures to "profit by experience," as well as for the acquisition of biologically meaningless response tendencies. The processes of association and reasoning—particularly in the human species—are frequently able to bridge the gap between the retroflex process and the actual cause of its arousal, and to transfer the effect in some degree to the really significant response tendency, even when the lapse of time is very great. We shall consider the mechanism of such transfers at a later point in our argument.

Another aspect of the retroflex process—as we have described it—which should be fully appreciated, is that in the majority of cases it is a function of the nature of the environment. What the individual will learn in accordance with the retroflex principle will not be automatically determined wholly by factors within his own organism, but must depend upon external circumstances. Hence the result will constitute a real adaptation to particular environmental conditions. We shall realize at once that this is true if we examine the manner in which nociceptive and beneceptive processes are set off in everyday life. Thus, the child is led to avoid candle-flames because of the injurious properties which such flames possess, and which enable them to excite the cutaneous pain nerves. Similarly, the acceptance of candy depends upon the ability of saccharine substances to arouse the saccharoceptive energies. If the child were placed in an environment where objects which look like candle-flames were actually saccharine, whereas those which resemble pieces of candy were uniformly at a high temperature, the habits which the child would form, with respect to the same visual patterns, would be the reverse of those which it normally acquires. At the same time, they would be the appropriate habits for such a changed condition of affairs.

In a like manner, more complicated adjustments, such as those required to win the erotic acquiescence of some particular person, will be determined through the medium of the sexual retroflex process so as to yield the desired results. The habits which are formed will be adaptive to the peculiarities of the person in question. If this person is removed, and a different one enters upon the scene, the retroflexes may act to undo the original habits and to establish different habits which, however, will subserve the same essential function of reproduction. It should be clear that heredity alone could not possibly establish the responses which are required in such situations, since they differ radically from one individual to another, and from time to time for the same individual. The retroflex system, however, provides an hereditary device which controls habit formation in a definite manner, but always so that it is a function not only of biological needs but of the circumstances under which these needs must be satisfied in the particular case at hand.

Chapter XIII

Retroflex Action and Classical Problems

We may now consider in some detail the applications of the doctrine of retroflex action, which we have outlined in the previous chapter, to a number of classical problems. These are principally concerned with the nature of particular kinds of learning, but also include some other phases of the theory of response. In studying these special applications, we shall endeavor to develop the conception of the retroflex process, itself, along certain lines which have not been adequately pursued in the preceding chapter.

121. *Instinct Explained by Retroflex Action*

It may be noted, in the first place, that the conception of specific retroflex action presents itself as a promising surrogate for that of instinct, particularly when the latter is interpreted along the appetitional lines which we have favored. It seems that all of the so-called appetitions are based upon either nociceptive or beneceptive excitations. They are all nociceptive with the exception of the sexual case, and we have inclined to the view that the erotic excitation is also nociceptive under conditions where it exhibits the characteristic appetitional effects. The special feature of *unrest,* which attaches to appetitions, has already been explained as a logical consequence of negative retroflex action. The law of this action is to inhibit all responses (by reducing their adjustor conductances) which appear while it continues. This law implies unrest, because the inhibition applies to postures just as much as it does to movements. Under nociceptive excitation, no movement or posture can persist, since, so long as it continues, its adjustor conductance is being reduced cumulatively and hence it will eventually be replaced by an alternative adjustment. This will suffer the same fate, and so on until the retroflex process is removed.

Each of the specific instincts or appetitions can be replaced by a corresponding retroflex system, usually nociceptive. This "replacement" is really nothing any more elaborate than the dropping of the terms, instinct and appetition, as indices of any distinctive factors in the response scheme. They may serve as convenient synonyms, to relieve literary monotony, or to indicate certain aspects of retroflex process, but the nature of each specific appetition is fully implied by the nociceptive activity which sets it off.

The relation between "instinct" and learning is particularly well accounted for by the retroflex conception, since the latter is especially designed to deal with learning and relates to instinct only incidentally. The theory shows how instincts are modified by "experience" and how they can have the flexibility which is required to harmonize them with adaptive behavior. The "retroflex" conception of instinct even satisfies the logical demands of a McDougallian "hormic" principle, according to which an instinct is a vague general tendency, picking out the line of behavior which can best minister to its ends in a given situation. The main difference is that the retroflex concept is not vague, and probably not "hormic."

However, the implications of the doctrine of retroflexes are much broader than those of appetition, as we have presented the latter in our own discussion. Appetite, as conceived by common sense, is certainly something more than discomfort and unrest. It involves a positive seeking process, in which some representation of the desired end plays an important rôle. As we have already suggested, some of these positively appeted ends can be identified with stimulations of beneceptive sense channels or the setting off of positive—as opposed to negative—retroflex processes. Thus, when a rat runs through a maze, he is driven not merely by hunger but by association of the maze with olfactory and gustatory stimuli which have a beneceptive effect. We shall develop the theory of some of these more positive aspects of "appetite" in ensuing chapters.

122. *Definition of "Success" in Terms of Retroflex Action*

It will be seen that the doctrine of retroflex action provides a satisfactory physiological definition of "success" and "failure," in trial and error learning. This is a matter which seems to have bothered many students of animal behavior. They have felt that "successful" responses should be "stamped in," and "unsuccessful" ones "stamped out," but they have defined "success" and "failure" in terms of the general biological situation, which does not seem to be equipped with the proper "stamping" mechanism. In terms of our theory, the trials are "successful" if they remove nociceptive stimulation, or bring about beneceptive stimulation. However, a "success," as thus defined, will not necessarily be the best possible way of fulfilling the biological end which is implied in the given situation. It will merely be the best attempt which has been presented, up to the given time, by the mechanism which develops the random movements. It may perfectly well happen that the response which removes an injurious stimulus, or which acquires a beneficial one, is extremely inefficient and that, in spite of this fact, no response having superior efficiency will appear during the lifetime of the individual. From an ideal standpoint, all responses—even those which are based by human beings upon advanced scientific analysis—fail to realize perfection in this regard. Among the lower animals, in particular, the efficiency of learned responses may be expected to be especially low, because of the limited repertory of alternatives which is available to them.

These considerations remove difficulties such as those which seem to have troubled Watson,[140] when he points out that it is not true that only "successful" acts are fixed by habit. He cites, as examples, the cases of an animal which always took an extra and unnecessary run around a problem box before it struck the latch which opened the box, and of a student who uniformly made useless spacing strokes on an adding machine before taking a total. However, these are not actually cases of "unsuccessful" behavior, but only of reactions which are lacking in reasonable efficiency. Offhand, the retroflex principle would seem to imply that the first form of response which satisfies the requirements of an appetition will be "stamped in," regardless of its probably low efficiency and that it will persist even in opposition to alternatives which are ideally superior. This tendency certainly accounts for the existence of a vast multitude of prejudices and relatively worthless customs in human life.

123. *Retroflex Mechanism of "Sensory Habit" Formation*

On the other hand, we are compelled to account for the cases in which an actual improvement in efficiency is recorded, during the course of a series of learning experiments. In studying these effects, it is advisable to classify the responses, which may be concerned, into two groups. In the first group, the required response may involve only a single movement, or a relatively simple series of movements which may be considered as belonging naturally together. Consider, for example, the act of an animal in entering one out of two alternative doorways, or of lifting a latch. In the second group, the required response comprises a series of movements which have an arbitrary order, so that they must be regarded as held together by bonds of association that have been established by "experience." As an example, we may consider the complex succession of runs and turns which an animal must make to pass through a maze. The two classes of responses are not qualitatively different, because even a so-called "single movement" is really a succession of movements, and "movement series" of any degree of complexity can be imagined.

Learning to respond with the correct single movement is presented most clearly in the classical method of testing animal powers of discrimination through the association of "reward" with one stimulus and "punishment" with another. Suppose that we wish to know whether a dog can discriminate between yellow and blue. We arrange two doorways, either of which he can enter, and place a yellow card above one and a blue card above the other. In different tests, the location of the cards may be interchanged, but we always feed the dog when he enters under the yellow, and subject him to an electric shock when he chooses the blue. If he is capable of making the required discrimination, the frequency with which he chooses the blue relatively to the yellow will be reduced during a series of experiments, until eventually he invariably selects the yellow. The explanation, in terms of retroflexes, is obvious. The response which consists of entering under the blue is reduced in conductance each time the shock is administered, this conductance change being cumulative throughout the series. Similarly, the response which consists in entering under the yellow is increased in conductance each time the food is taken, until the difference between the two adjustments is sufficiently great to counteract the general tendency to random action, which otherwise would cause a fluctuating choice.

It will be perceived that the analysis which has just been given can be regarded as a purely physiological interpretation of Thorndike's much maligned "law of effect." Watson says that it would more appropriately be called a "law of cause." Our present view seems to favor Thorndike's original description, since the retroflex process is determined by the effect of the given response. We might, however, also follow Watson and say that it is characteristic of the retroflex to transform this effect into a cause, which acts so as to modify the operative cortical tendency or response system in a biologically valuable manner.

124. *Explanation of the "Problem Box" Experiment*

A somewhat different situation from that which obtains in the discrimination experiment upon animals—where so-called "sensory habits" are formed—is that of the problem box. Let us suppose that a hungry animal is inside of the box, and that there is food on the outside. The hunger involves a nociceptive process, bringing about a reduction in any conductances which may function while the animal remains hungry. Therefore the animal should exhibit continuous random activity, each incident movement or posture being inhibited and replaced by another which suffers the same fate. This principle will not necessarily prevent particular forms of response from being repeated, since a reduction in the tendency for a given response to occur may not put it forever out of the competition. A subsequent reduction of other alternative responses may readily result in its becoming dominant once more. Nevertheless, we must conceive that the entire group of responses is being subjected to a general depression of conductance. Finally, a reaction occurs which operates the latch and permits the animal to escape from the box. Straightway, it rushes to the food, seizes and swallows the latter, and the hunger soon disappears.

Now the last response in the series of trials will be subjected to the inhibitory influence of the hunger over a shorter period of time than will have any of the preceding responses. This will be the case, particularly, if we make use of the principle—already vindicated—that any response which has occurred continues to be affected by retroflex excitations which operate subsequently to its termination, although this influence wanes progressively as time passes. To put the matter mathematically, the "time integral" of the retroflex effect upon the various members of the response series will be less in the case of the concluding than in the case of any other member of the series. But this is not the whole story. The olfactory and gustatory stimululations which follows from the seizing of the food have a positive retroflex accompaniment, which will *increase* the conductances of the response adjustors in proportion to their recency. Consequently, the final, and so-called "successful," response will not only be the least inhibited, but it will also be the most facilitated one among the various "trials." The acts of rushing out of the box and grabbing the food with the teeth will, of course, be facilitated even more—and inhibited even less—but these are not of interest in our present analysis.

If we accept this line of reasoning, we should expect that when the animal is returned to the box, the response which enabled it to escape, upon the previous occasion, will be more liable to be aroused by the stimuli which are afforded within the box, than will any alternative response. However, it does not follow that this reaction will ensue immediately. In the first place, the stimulus situation may not be the same. If the animal is not hungry, the stimulus pattern and afferent nerve currents are modified by the elimination of certain factors which may be essential to the arousal of the required response. Also, the odor of the food may be a requisite element in the stimulus configuration. The exact position of the animal in the box at any moment helps to determine the stimuli which set off its responses. If its eyes do not happen to fall upon the particular part of the box which it must manipulate in order to escape, the response cannot be set off, no matter how conductive it may happen to be. In addition to these general considerations, the augmentation of the conductance of the successful type of response may not have been sufficient during a single trial to counteract all other response tendencies, and, particularly, the forces which make for random movement. Nevertheless, we should expect that after a considerable number of escapes have been made, the accumulation of relative conductance increase on the part of the successful response should place it in a position of such dominance that it should occur very quickly after the animal has been placed in the box, provided that the general stimulus pattern is appropriate.

125. *The Retroflex Interpretation of "Recency and Frequency"*

It is interesting to consider at this point the interpretation which must be given to Watson's principles of "frequency" and "recency," to harmonize with our doctrine of retroflexes. In general, we might expect a form of response which is continuously unsuccessful during the action of a nociceptive excitation, to disappear from the scene, or, at any rate, to show a reduced tendency to recur. In other words, there may be some effect similar to that required by Watson in order that his principle of frequency should have any validity. In terms of the simile of drawing cards from a hat and failing to return them, we can say that negative retroflex action may take some of the cards semi-permanently out of the hat. However, even in this case, no direct credit can be given to the principle of frequency, since the chances are "loaded" by the principle of "effect." If they were non-loaded, the frequencies would be equal on the average.

The superior "recency" of the successful response depends upon its *terminal* position, and in order to understand the meaning of this feature we must see what controls "termination." The series of trials to escape from the box naturally ceases when the escape is effected. This, however, is not the end of the response to the hunger situation, since the animal now runs forward, grabs the food, hurriedly masticates and swallows it. Soon, the hunger is partly or wholly appeased. Response to the given situation may then be said to have terminated. Termination is therefore signalized by the removal of the nociceptive retroflex, and also by the incidence of the beneceptive retroflexes of taste and smell. The "recency" of the terminal response is determined by these processes, which seal off the given behavior episode, and liberate the animal to the influence of other classes of stimuli.

However, the importance of "recency," as such, is probably very slight. The maximal proximity of the so-called final response to the removal of the nociceptive action, and the incidence of the beneceptive one, is the real controlling feature of the learning process. The result would be practically the same if the series of movements went on *ad infinitum,* but at certain points in it the inhibitory (nocicepceptive) action was alleviated or certain facilitative (beneceptive) stimuli were introduced. All of the responses occurring during the intervals of negative retroflex action would lose conductance, whereas those taking place when this influence was lifted would be relatively unaffected. On the other hand, the responses occurring contemporaneously with the introduction of the beneceptive processes would be increased in conductance.

126. *Learning Sequences of Movements*

Another situation which we must consider is that in which the animal or person is required to execute a simple but definite *sequence* of movements in order to satisfy an appetition. We may consider the case of a special problem box in which a number of latch units must be operated before the box will open. The arrangement may either be such as to require a fixed order of operation, or the order may be irrelevant. Such problems will evidently be much more difficult for the animal to solve and learn than those in which only a single reaction is required. It would seem that in order that a clear-cut retroflex selection should be made, the necessary combination of reactions must be made in close succession, so as to place them all at the end of the series of trials. If one member of the combination occurs early in the experiment, and another at a later time, while a third one is required to open the box, the earlier members will be subjected principally to inhibitory action. Only the final member will be facilitated, and this alone will not suffice to establish the combination as a habit. Hence, we might suppose that the animal would be forced to continue its trials until it happened to hit the right combination of movements in close succession, so that the group could be facilitated as a whole. This will eventually occur as a result of chance, but its probability is low compared with that for the occurrence of any single isolated response. In accordance with the mathematical theory of combinations and permutations, the difficulty of the problem must increase with the number of elementary reactions, and the special requirements as to order of sequence.

It can be shown, however, that even when the required reactions do not occur in close sequence, there will be some tendency for them to be learned. The reasoning is as follows. We must consider the accumulation of conductance changes over a large number of experiments. If the required combination of movements does not appear, the experiment will be indefinitely prolonged, and the responses which do occur will be subjected to a continuous depression of conductance which will be proportional, on the average, to the duration of the experiment. But if the required set of movements occurs, no matter how they may be spaced in the total period of the experiment, this period will be shortened; so that the reactions occurring during this experiment will be subjected to a lessened average depression of conductance. Among these reactions are the members of the required combination. If we summate the conductance changes of all actually occurring reactions over a considerable number of experiments, we shall find that the total depression of conductance of the required reactions will be less than that of other reactions which make no contribution to success. Hence the required reactions will tend to predominate in the long run.

When a definite order of reaction is demanded—as in one of Watson's problem boxes—the adjustor elements must be bound together physiologically in some manner. No amount of stamping in of the individual members of the permutation will suffice to guarantee the proper order. The mechanism of ordered association may be that of the "chain reflex," in which one reaction furnishes the stimulus for the next; or it may depend upon some purely motor organization. In the latter case, the group of movements really becomes a single response, which can be treated by the retroflex principle as if it were a simple unit. The establishment of such associational combinations is a natural result—in animals having a sufficiently high degree of nervous organization—of the actual sequence of "experiences."

If a set of reactions occurs in a given order in one experiment, this will tend to lay down a record which represents the order in question; and this record may constitute an important part of the total mechanism which is "stamped in" by the retroflex activity. Animals whose neural organization is so primitive as not to permit of such associational recording, are unable to learn the solutions of complex problems. They may occasionally solve them by pure accident, but they will be unable to retain the solutions in the form of habits.

127. *The Retroflex Explanation of Maze Learning*

The question as to how complex a series of definitely associated movements can be and yet be treated as a single motor unit, is an interesting one. The case of maze-running by such animals as rats reveals highly intricate sequences of this sort. The very admirable studies by Watson [141] show that these maze-running movements are independent of stimuli acting through any class of exteroceptors, such as the eyes, nose, ears, touch, etc. The learned sequence of movements seems to be fixed on the motor side; from the start of the run the rat has learned to take so many steps forward, turn to the right, take a different number of steps, turn to the left, and so on. He does this just as well in total darkness as in the light, and depriving him of his olfactory end-organs, vibrissae, etc., has no influence upon his habit or his ability to learn. This leads Watson to believe that the movements are set off by proprioceptive impulses. However, *a priori,* it is equally probable on the basis of Watson's data, that the rat's movements have an entirely central-efferent or incito-motor basis, following a set mechanism of efferent innervation, which, when once started, requires no afferent control. Nevertheless, other evidence makes us feel certain that the rat would be unable to learn, or to run the maze after having learned it, if deprived of proprioceptors; since the proprioceptive impulses are intimately bound up with the coördination of voluntary movements. However, these impulses are internally determined by the motor apparatus itself, so that the maze-run can be regarded as a single response, in spite of its apparent complexity.

Let us consider the case of a rat which learns a maze under the influence of hunger. In a series of thirty experiments which are reported by Watson, the first successful trip required twenty-nine minutes, while the last one took only thirty seconds. Let us regard each trip as a separately controlled response. Then it will be evident that the adjustor for the first trip—which included much wandering around in blind alleys, turning back, etc.—will be subjected to the inhibitory influence of the hunger currents over a period nearly sixty times as long as that for the thirtieth trip. Consequently, the summated depression of conductance for the first trip form of adjustment will be very great compared with that for the last trip form. This must mean that as the rat varies his methods of travel, from one experiment to another, the methods which involve the shortest time will constantly be favored above others. Hence, during the course of the thirty experiments, the less efficient sequences of innervation are progressively discarded in favor of more efficient ones. When a response has finally been found which follows the "true path," or shortest line through the maze, the choice among alternatives will tend to cease and improvement thereafter will be restricted to an increase in the efficiency of this particular response system.

We do not, however, need to rely entirely upon the accumulation of *inhibitory* influences while the maze is being run. The most impressive event from the standpoint of the animal is probably the actual finding of the food, with its accompanying beneceptive and positive retroflex excitations. If the entire maze-trip is represented in the cortex by a coherent associative mechanism, we may expect the conductance increase, which accompanies these excitations, to apply to the entire system and not merely to the end-members. This effect would operate, or be transmitted through the chain of associations, leading from the last movement retroactively towards the first. We should expect the magnitude of this retroactive action to be proportional to the strength and intimacy of the associations; in other words, to the unity of the combination of responses. Two factors which militate strongly against such unity are complexity and remoteness of components in time. Consequently the transmission of the facilitative influence will be relatively weak for long, inefficient chains of responses, and much stronger when the chain is shorter and the impressions are more recent. Hence, the most efficient mode of travel through the maze will receive the greatest facilitative enhancement, as well as the least inhibitory depression. The total or resultant conductance change for each different way of passing through the maze will be determined by an algebraic summation in which the inhibitory effects are pitted against the facilitative ones. It will be perceived that the algebraic sum will always be in favor of the series of responses which solves the maze in the least possible time, and involves the smallest number of elementary reactions.

The above argument can be supplemented by an examination of the retroflex influences which are exerted upon the elementary reactions, considered either as separate units, or as parts of the response chain. In the early stages of learning, the unification will presumably be less than in later stages, so that in the former case the effects upon the separate components will be of maximal importance. During the first trials in a maze, an animal wastes a great deal of time in blind alleys and *cul-de-sacs*. It is a matter of chance that the animal turns into a blind alley, but he cannot remain here quietly, because the response posture which would be involved in so remaining is inhibited by the hunger retroflex, and a different form of behavior must supervene. As the animal passes from one turn of the maze to another, it is constantly replacing the older, inhibited, responses by new ones, corresponding to the advanced positions. If the true path is being followed, the individual unit responses are active during a minimal period of time but, when a false path is taken, the time is increased for the units which involve the non-progressive path components. The physical impossibility of effecting a passage, the resulting inhibitions, hesitation, retracing of steps, etc., all add to the delay in connection with the responses to these latter components; hence, they will be depressed on the average more than will responses to components of the true path.

In addition to the selective action of the continuing hunger excitation upon the elementary responses in a series, there may be other causes of a depression of the conductances for certain of the elements. If a blind rat bumps a vibrissaless nose against the wall of a *cul-de-sac,* the pain retroflex will exert an important inhibitory effect. If the vibrissae or eyes prevent such a bump they probably do so through an associative arousal of the same kind of action. Watson's experiments show that such influences are not the essential factors in maze learning, but they may be of great importance in other situations which require ordered movements. When a rat is running an elevated maze in the form of a high trestle-work with no containing walls, the "fear of falling" coöperates with hunger as an inhibitory influence, throughout the trip. This "fear" consists physiologically in an associative arousal of the pain retroflex.

128. *The Characteristic Effects of Positive Retroflex Action*

Facilitation of individual response elements in a series will usually depend upon a transmission of the facilitative influence along the lines of association which hold the elements together. Weak associative linkages will be unfavorable to such transmission. However, the exact nature of the action will depend upon the kind of experimental or natural situation which is involved. In the case of sexual response, after the erotic excitation has reached a sufficient intensity to fall into the beneceptive range, all responses will be facilitated, but those which raise the intensity of erotic action will be facilitated to a greater degree than will those which leave it unmodified, permit it to decay, or actively depress it. Consequently, although the erotic—or any other positive retroflex—will tend to establish any response which is contemporaneous with it, the effect will be greatest upon those responses which accompany the greatest erotic intensity. Consequently, the latter will dominate over the less facilitated tendencies when the situation is repeated, the *relative* effect being the same as in nociceptive action. In general, that series of reactions will tend to be established which increases the intensity of erotic excitement most rapidly.

It is evident that the behavior phenomena which accompany positive retroflex action must differ considerably from those which are characteristic of the corresponding negative process. In the first place, there will be no tendency towards random movement, so far as the influence of the retroflex principle, itself, is concerned. All movements and postures will tend to be "stamped in" and retained. The variations of behavior which actually occur must be attributed to a general tendency of the cortex to respond in a fluctuating manner, regardless, to a certain extent, of retroflex excitations. As we have seen, this normal fluctuation of conductance values has to be overcome in all learning processes. However, a strong positive retroflex submerges it very quickly. Consequently, it is not surprising that particular forms of erotic and alimentary response are fixed quite easily, and frequently are not overcome by any alternative form throughout the lifetime of the individual. So-called sexual perversions are at least partially explicable on this basis.

However, if a given form of sexual response continuously fails to contribute effectively to erotic excitation, it is very likely to be replaced by other more efficient reactions. Such failure may be a consequence of processes of adaptation, "loss of novelty," etc., the details of which we shall discuss in later chapters. On the other hand, if some secondary influence—such as an outside inhibition or a physiological defect of excitability—limits the erotic process so that it cannot reach an intensity which is sufficient to bring about the consummatory reflexes, there may be an especial facilitation of low potential erotic responses. This will be referable to the integration of the conductive increases of these responses over the protracted period of time. In this case, there will be a natural development of forms of response which maintain the erotic excitation at a level which is less than that required to bring about the consummatory reflexes, even when the latter have become possible. This is at least part of the explanation of phenomena of dalliance and overemphasis of the *Vorlust* phases of sexual response, which are observable not only as an aspect of Neo-Malthusian practices in the human race, but also in the behavior of animals.

The commonest effect of positive retroflex excitement is to stamp in, very forcibly, the simple movements which are physiologically adapted to continue and heighten the process in question. In the case of erotic sensibility, these are evidently the movements of the coitus. In the case of the beneceptive aspects of taste and smell, they are the movements of ingestion, mastication, deglutition, etc. However, the positive retroflex will always retroactively enhance the more contingent forms of response which have led up to these consummatory reactions, in the "experience" of the particular individual who is concerned.

129. *The General Law of Retroflexes*

It may be noted as a general principle of both positive and negative retroflex action that, other things being equal, they always act so as to reduce the inhibition to a minimum, or to raise the facilitation to a maximum. Retroflex inhibition is a self-destructive process, whereas retroflex facilitation is self-enhancing. If we apply our definitions of inhibition as a negative rate of change of conductance, and of facilitation as a positive rate of change in the same variable, then the proposition which we have just stated can be given a very unitary formulation. This is to the effect that the general tendency of all learning is to raise the positive rate of change of the operative cortical adjustors to a maximum.

In mathematical terms, if c is the conductance of the operative cortical adjustor, then the tendency of learning is expressed by the equation: $dc/dt = max$. The value of this maximum is restricted by the range of alternatives which are presented by the total response repertory of the random movement tendencies in the given animal. The maximal value of dc/dt to which we have here referred may be characteristic of the learning process only, and not necessarily of the operation of the responses after they have been learned.

Chapter XIV

Secondary Retroflex Action

The form of retroflex action which we have discussed in the two preceding chapters may be designated as *primary*. Primary retroflex action consists in the increasing or decreasing of the operative, or recently operated, cortical adjustors as a consequence of the direct excitation of beneceptive or nociceptive channels, respectively. We have seen that this device furnishes an instrument for the fundamental process of learning by "trial and error." The basic assumptions which underlie our theory of such learning are, first, those of the general cortical mechanism; second, random activity; and, third, the retroflex principle, itself. It is now our purpose to consider some further implications which arise from the introduction of a fourth principle.

130. *Conditioning a Retroflex*

The principle in question is the very familiar one of the *conditioned reflex,* although we shall now apply it to retroflexes, rather than primarily to reflexes. We have seen that, in accordance with Pawlow's law—which governs the process of conditioning—a mechanism of efferent expression which has a natural specific stimulus may acquire a different stimulus, through association of the latter with the natural stimulus. We have designated the natural stimulus as "primary," and the acquired one as "secondary." We have noted that Pawlow's law is novel only in that it applies or demonstrates the older and more general principle of *redintegration* in a purely physiological subject-matter.

Now, if we consider the probable neural mechanism of conditioning, and of the conditioned reflex when once it has been formed, we are led to suppose that the essential changes occur in the adjustor stage of the response. A new afferent pattern is attached to the old efferent mechanism, and this attachment must occur at a nerve center. The studies of Pawlow and others show clearly that the adjustors in question are located in the cerebral cortex, although for the operation of the conditioned reflex the essential spinal centers are also apparently necessary. It is to be presumed that the cortical representation of the primary stimulus becomes combined with that of the secondary stimulus in a single afferent cortical synergy, which is in control of the spinal or medullary center for the reflex, through efferent channels. At a later time, the secondary stimulus is able to arouse the neurogram as a whole, and thus to transmit the same efferent impulses and to set off the reflex center as before. After the conditioned reflex has once been formed, we might eradicate the entire efferent side of the neural mechanism, without destroying the essential associative condition, which resides on the afferent sector of the cortical system of records.

Now, if these ideas are correct, we are certainly justified in inferring that the conditioning principle will apply to retroflexes as well as to reflexes. Each specific retroflex is subject to a specific primary stimulus. If this stimulus operates upon the cortex simultaneously with a different stimulus, the two should combine "entegratively" to yield an associative record. When the secondary stimulus again appears it should be able to rearouse the neurological processes which were associated with this record when it was produced, and these would include the retroflex activity. If these retroflex activities are engineered—as we have supposed—by centers in the thalamus, such thalamic centers could be regarded as occupying a position entirely analogous to that held by the reflex centers in the case of the simple conditioned reflex. The path of the nerve conduction in the case of a conditioned retroflex would thus be: (1) secondary stimulus to cortex, (2) cortex to thalamus, (3) thalamus to cortex. The third step in the sequence would involve facilitative or inhibitory action of the same general kind as that which accompanies primary excitation of the retroflex processes.

Although retroflexes are to be distinguished clearly from reflexes, nevertheless, they are practically always accompanied by reflex changes. Thus, if the retroflex in question is based upon the receptors of pain, it will be accompanied by the sympathetic innervations and other characteristic reflex efferent attachments of the pain channels. Accordingly, the formation of the conditioned retroflex will ordinarily be paralleled by that of conditioned reflexes. The secondary stimulus will simultaneously arouse the facilitative or inhibitory process and the characteristic automatic motor effects. However, the phase of the matter which we wish to consider in the present chapter is that of the associatively set-off retroflex. For the time being, we may take the reflex effects for granted.

131. *Principles Involved in Conditioning Retroflexes*

The establishment of a conditioned retroflex or reflex must be regarded as an act of learning. However, it is quite a different type of learning from that which we have considered in the preceding two chapters. Although this associative learning may occur in the course of a "trial and error" experiment, it is not itself subject to trial and error. The mechanism of conditioning is simply that of afferent sensory impression, depending upon two general properties of the cortical tissue, first, its tendency to take a record, and, second, its tendency to unite all of the components of such a record. The unification tendency not only applies to exactly contemporaneous components, but also to some extent to successive ones. However, successive integration is feeble in proportion to the separation of the components in time. If we assume that the general functional tendency, which characterizes the process which we have called entegration, has a unifying action apart from its ability to record impressions, we can explain the latter action completely by means of the general law of exercise. This law, as neurologically expressed, states that the conductance of any cortical path tends to be increased by the mere passage of a nerve current. Where a complex system of such paths is involved, the conductance increments will naturally conform to the exact patterns of functional discharge which are occurring through them, thus recording not only the special configuration of the process, but also its integrative character. Consequently, we need not feel any necessity of calling upon the principle of positive retroflex action to account for the production of such increases in cortical conductances as are comprised simply by afferent records of the character which are here being considered. On the other hand, it is quite possible that positive retroflex action may sometimes assist in the laying down of afferent records, or, again, that negative retroflex action may interfere with this process.

This leads us to emphasize the point that retroflex action applies itself primarily to the conjunction of afferent and efferent patterns rather than to the formation of such patterns. The conductance which is primarily subjected to retroflex action is that which determines the specificity of the response, namely, the essential link between a particular afferent process—symbolized by the stimulus—and a special efferent process—symbolized by the motor reaction. It is highly probable that efferent as well as afferent conduction patterns are laid down mainly by exercise rather than by retroflex action. The effect of the latter upon efferent patterns is probably restricted in many cases to the acts of selecting them to be exercised, or of ruling them out so that they fail to be developed by practice.

132. *Examples of the Operation of Conditioned Retroflexes*

Let us consider an example of the conditioning of a specific retroflex, together with the consequences of this event. We may utilize the familiar case of the child and the candle flame. We have seen that the experience of the child with this object leads, through primary retroflex action, to a reduced tendency to react to the flame image by thrusting the finger therein. However, this effect does not in itself imply that when the flame is again seen there will be any further inhibition of response, as a consequence. On the contrary, it would seem to guarantee the absence of such inhibition, because the child will fail to place its finger in the flame, and hence the pain nerve will not be excited. However, if we study the behavior and also the mental processes of the child when it sees the flame the second time, we find that something has happened besides a mere reduction of the tendency for the child to react disadvantageously to the flame. This fact is expressed in the familiar phrase: "The burned child fears the fire."

Now, "fearing the fire" might be construed to mean—among other possible things—that the child exhibits reflexes similar to those which are set off by pain stimulation. Its sympathetic nervous system is now aroused by the mere sight of the flame, it begins to cry, manifests withdrawing movements, etc. These manifestations, by themselves, merely constitute conditioned reflexes, or else an expression of the particular voluntary movements which have been established by the original experience with the candle. However, if we study the burned child's behavior in connection with visual stimulation by flames, we shall find that the candle flame image has now assumed a power to control the learning processes of the individual. If the child enters a room in which there is a flame, he may run out of the room and, later, may show an aversion to entering it again, even if the candle is then absent. If a particular person approaches him with a candle in hand, this person will later become an object of fear or aversion, even when not carrying a flame. We can conclude from such observations that the flame image has now become able to inhibit responses, or adjustors, which operate contemporaneously with the incidence of this image, so that the latter has assumed the powers which congenitally belonged only to the pain excitations. In other words, we are dealing with a conditioned retroflex.

The same kind of reasoning is obviously applicable to the case of a positive retroflex, such as that which is set off by saccharine gustatory stimulation. The child who has once had experience with candy does not merely seek and accept confections in the future, but he develops a liking for all circumstances under which candy is obtainable. He finds these circumstances to be attractive even when candy is absent, if they have once been associated with the procuring of such sweetmeats. Consequently, we can infer that the mere visual image of candy has now become able to facilitate the responses, or adjustors, which are operative simultaneously with the existence of such excitation images.

Conditioned retroflexes, as thus defined and described, furnish the actual basis of most of the "trial and error" learning of the mature human being, and in fact of all who have passed beyond the early years of infancy. Of course, primary retroflex action continues to operate when occasion demands, but the more complex adjustments of adult life are based upon the associative arousal of beneceptive and nociceptive tendencies. Our efforts are applied, not toward the direct avoidance of pain, but toward the avoidance of conditions and objects which have long since been thoroughly demonstrated to be capable of arousing pain. The course of our learning and conduct is constantly directed toward the complete avoidance of actual nociceptive excitation, and we are successful to a high degree in this respect. In the case of positive retroflex or beneceptive processes, on the other hand, our behavior is controlled by a tendency to seek a maximum of such excitation, so that the primary positive retroflexes play a more important rôle in adult life than do the primary negative ones. Nevertheless, in the struggle to secure such primary beneceptive stimulation, our action is constantly being guided by secondary stimuli which arouse the positive retroflex processes associatively. In a great many cases, such associative arousal becomes a surrogate for the actual primary arousal. This is particularly the case in the domain of sex.

133. *Pyramiding the Conditioning Process*

It is to be supposed that the process of passing on the ability to facilitate or to inhibit cortically determined responses may be continued from one stimulus to another *ad infinitum.* Thus, association of a candle-flame with pain endows the former stimulus with positive retroflex power, and association of the candle-flame with the image of a particular room can bestow the same power, in turn, upon the room, producing what we might call a *tertiary* retroflex system. It is not to be inferred, however, that the retroflex ability is taken away from the secondary stimulus by such bestowal of ability upon the tertiary one; there is simply a progressive enlargement of the field of stimuli which are capable of setting off the retroflex processes. When a number of associative links of this sort are required in order to trace back the relationship between the derived retroflex stimulus and the primary one, we may find it quite difficult to make a diagnosis of the system. It may seem that there is no explanation for the ability of the given stimulus to operate the retroflex mechanisms. Why should one faint at the sight of a maltese cat, for example? However, in each case, we must believe that a complete account of the individual's history will reveal all of the necessary associative linkages, and show that the primitive basis of each "aversion," or "liking," lies in a simple sensory retroflex mechanism.

One of the most important types of secondary or conditioning stimuli to retroflex processes is that of verbal symbolism, or language. Specific *words* are normally associated with all important stimulus features of our environment. When any one of these features becomes attached to a retroflex mechanism, the corresponding word acquires a similar attachment. As a rule, the retroflex forcefulness of the word will not be quite as great as that of the stimulus itself, but it should be expected to exert some effect. More important still is the fact that each of the sensory activities which is innately connected with retroflex processes has its own name. Thus, the words, "pain," "lust," "sweet," "sour," etc., are linked directly with the nerve excitations which naturally arouse either the facilitative or the inhibitory influences. These direct names should be expected to have a particularly potent influence. Hence we can control learning in human beings who are capable of understanding language by threatening them with pain, or by promising them sexual or alimentary stimuli of a facilitative kind on condition that they pursue a certain line of conduct which may also be represented to them in verbal terms. There are other verbal symbols which also have strong facilitative or inhibitory effects of this sort, which are not explicitly representative of the beneceptive or nociceptive mechanisms. These are the terms of common morality, such as "good," "bad," "right," "wrong," etc. We shall consider the detailed operation of some of these verbally conditioned retroflexes in later chapters.

134. *Conditioned Retroflexes and "Instincts"*

It will be our view that secondary or higher derivative retroflex mechanisms correspond more closely than do primitive appetitions to the common view of the nature of "instincts." The notion of an instinct, as propounded by McDougall, definitely involves a specific sensibility to pattern stimulation,[142] or what he calls a cognitive disposition. We have already stated our reasons for believing that such pattern-operated responses must have too intricate a mechanism to permit them to be established by heredity. Nevertheless, most of the forms of response, which McDougall regards as instinctive, rest upon stimulation of this sort. Now, it would seem to be fairly legitimate to speak of derived retroflex processes as *instinctive,* since they have an essential core of hereditary mechanism, but the association between their afferent excitants and the central and efferent mechanisms is a consequence of "experience" and environment. In some ways, this conception of the meaning of "instinctive" harmonizes well with McDougall's views, but many of his fundamental instincts are conceived in such a way that they necessarily imply a patterned stimulus; so that we cannot account for their supposed properties on the ground that the pattern sensibility has been acquired.

The ordinary conception of the sexual instinct definitely involves the idea of heterosexual determination which, in the human being, certainly rests upon very specific patterned stimuli. The common sense notion of the sex instinct would become rather barren if the specific desire of the male for the female and *vice versa* were eliminated. McDougall definitely adopts the view that the male has an inborn visual sensibility to the female form. However, we shall later see that we can account for all of the actually demonstrable facts of the so-called instinctive behavior in sex relationships by combining the much simpler notions of the sexual retroflexes and reflexes with that of the learning process, as we have presented the latter. Allport's discussion of this matter (Social Psychology, p. 71) is satisfactory.

It will be noted that the conditioned retroflex also bears a close similarity to that of the *complex,* as described by Freud or McDougall; and to the *sentiment,* as defined by McDougall or Shand. Since we are now dealing in purely physiological terms, we cannot refer to the affective or other psychological aspects of this notion. As conceived by Freud, the complex is a subconscious or unconscious psychical entity. McDougall also regards a complex as a "system of mental dispositions." However, he pays considerable attention to the physiological foundations of complexes in general, and these do not differ greatly from our conception of the mechanism of the conditioned retroflex. An established mechanism of this sort may be regarded in terms of our present theory, as constituting the physiological basis of the phenomena which are discussed by Freud, McDougall and the psychoanalysts in general, as manifestations of complexes. The affective aspect of the complex is represented, of course, by the retroflex process—although, at the present point in our discussion, without implying any actual affectivity—whereas the associated ideas or perceptions correspond with the patterned neurograms in the cortex. The attached mechanisms of efferent expression include reflex as well as learned movements.

135. *Complex Conditioned Retroflexes*

It should be noted that the formation of conditioned retroflexes is not limited to the simultaneous involvement of single primary retroflexes. Any number of primary retroflexes, up to the total which is provided by heredity, can be involved in such a system. Thus, a person who has been placed under circumstances which have simultaneously aroused pain, cold, hunger and other nociceptive excitations, will associate the representation of the circumstances in question with this entire group of negative retroflex tendencies. A coöperative inhibitory system of this sort must be expected to have a greater power in determining further learning than would one which is based upon only a single nociceptive channel. Furthermore, it should have more force in this direction than any single primary retroflex within the given group. Conditioned retroflexes which involve more than one primary retroflex mechanism may be designated as *compound*.

A very interesting case arises when a compound conditioned retroflex embraces positive as well as negative components. In this case there is a competition between two algebraically opposed operations, one of which tends to increase the cortical conductances, while the other tends simultaneously to decrease them. The resulting effect may actually be determined by an algebraic summation of the two conflicting tendencies, depending upon the relative intensities of the two processes; or, on the other hand, there may be a definite interference between them of an "all or none" character, so that either one or the other dominates—to the complete exclusion of its opponent. A situation of the latter character seems to underlie the so-called "repressed complexes" of Freudian theory. These complexes involve the simultaneous association of a given afferent pattern with both noci- and beneceptive activities. Thus, the given pattern may be capable of setting off the erotic forces, while at the same time it arouses the pain mechanism, either by direct or indirect associative connections. Practically all sexual activity amongst human beings is subject to some degree of conflict of this sort; the tendency toward sexual gratification being opposed by "fears," which have a social or an economic condition. Conditioned retroflexes which simultaneously involve positive and negative primary tendencies may be designated as *mixed*.

An interesting case of a mixed conditioned retroflex occurs when the primary stimulus to a negative retroflex process becomes a secondary stimulus to a positive process of this sort. For example, the simultaneous arousal of pain and of erotic excitement should be expected to form an associative system by which either (1) the pain stimulation can cause erotic excitement, or (2) the erotic excitation becomes "painful." Because of the opposition here, we should anticipate that one or the other of these tendencies will dominate. In the first case, the individual will be "masochistic," or will take pleasure in painful stimulation (under the given conditions), whereas in the second case there will be a development of erotic frigidity.

Positive and negative retroflex mechanisms may also combine with a single complex cortical neurogram in such a manner as to reinforce one another, rather than to interfere. In this case, the negative retroflexes operate to inhibit responses of one class, while the positive tendencies facilitate responses of a naturally opposed class. Thus, in general, all of the retroflexes coöperate to support a system of cortical impressions which is concerned with the welfare of the given individual. A cortical organization of this sort underlies what is known as the *ego complex*.

In later chapters, we shall consider the formation and constitution of particular complexes or conditioned retroflexes, in detail.

Chapter XV

Fundamental Psychological Phenomena and Their Correlations

Thus far, we have followed the methods of thought which are so prevalent among psychologists of the behavioristic, or quasi-behavioristic, schools. We have shown that it is possible to work out a consistent account of certain behavior processes without any reference to consciousness. The behavioristically inclined psychologists seem to feel that their adherence to purely physiological, or so-called "objective" considerations, endows their thought with particular intellectual sanctity, whereas excursions into the introspective realm involve scientific turpitude. Now, it is not our intention to deny the possibility of completing a doctrine of motivation in purely physiological terms. However, we most assuredly do deny both the necessity and the utility of formulating the entire account in such language. Even if the most powerful motive of an author is to advocate some sort of supposedly original and radical doctrine, the appeal of the so-called objective attitude will by this time have lost most of its force. As a matter of fact, this kind of reasoning is as old as Descartes and LaMettrie.

On the other hand, it is obvious that we shall not progress very far if we adhere entirely to introspectively or psychologically conceived notions. In this case, we are apt to flounder in a slough of vague ideas, after the fashion of most of the psychoanalysts. Now that we have had so much elusive mentalism, and so much exclusive behaviorism, the path of advance, and even of originality, would seem to lie evenly between the two contrasted domains.

We may evaluate the two methods as equal and insist upon a *psychophysical* account, in which we regard the mental and physical factors as of coördinate importance, the problem being to develop an explanatory system which will include them all. This is the line of thought which we shall now begin to elaborate.

136. *Objections to an Exclusively Behavioristic Account*

We may devote a few more words to a criticism of the behaviorist's position, particularly as it applies to the problem of motivation. This problem is one which has peculiar "human interest." It is concerned with affairs which are of common occurrence and notice in the everyday lives of men and women. Very few everyday people have ever heard of the ideas which the behaviorist applies to their behavior, and they would not and probably could not understand the behaviorist's explanations. They would view them as fantastic parodies. Nevertheless they could appreciate, and even formulate for themselves, problems of motivation, expressing these problems and their solutions in terms which more closely approximate those of introspective psychology than they do those of physiology. It hardly seems that a theory of motivation can be really satisfactory if it fails to interpret these commoner ways of thinking about some of the most absorbing facts of human life.

If we examine the behaviorist's position from a strict methodological or epistemological standpoint, we find that its justification can really only be based upon a plea of intellectual incapacity on the part of the behaviorist himself. No matter how specialized a behaviorist's own experience may be, he is actually compelled to base all of his reasoning upon introspective data consisting of his own or some other behaviorist's observations or inferences. He is thus founding his doctrines upon a psychological basis, but he assumes the privilege of rejecting any phenomena which are difficult to explain. He throws out of the situation his own perceptions, thoughts and feelings, except insofar as they relate directly to supposed physical objects. He points out that introspective psychology has thus far failed to justify its claim to be a natural science, and by his rejection of the cardinal facts of experience, does his utmost to make this unsatisfactory status permanent.

Now, it should be evident by this time that the present writer is very sympathetically disposed toward so-called objective or physiological theorizing, and is quite willing to accept the proposition that a logically coherent scheme of biological processes can be developed without any reference to consciousness. However, such a scheme is incomplete and humanly unsatisfactory, because it leaves out of account the very phenomena which really interest us the most. Even for the radical behaviorist, the system of physiological explanations is just one rather insignificant item in a vast array of psychological phenomena which present themselves to him in his everyday experience. His behaviorism is actually subsidiary to the perceptions, thoughts, and feelings which revolve around and support the behavioristic argument. What we require is a system which provides us with a clear and logically coherent formulation of the entire group of facts and principles, whether they lie in the class which the behaviorist accepts, or whether they belong in the outcast realm of everyday life.

Semi-behaviorists, such as Allport, feel that it is impossible to establish any satisfactory relationship between psychological and physiological terms, so that we are compelled to adhere to the purely physiological method. Allport says: "It is clear that consciousness stands in some intimate relation to the biological need and the behavior which satisfies it. Just what this relation is still constitutes an unsolved and perplexing problem. . . . Explanation is not derived from desire, feeling, will, or purpose, however compelling these may seem to our immediate awareness, but from the sequence of stimulation—neural transmission—and reaction." He goes on to say that if the reader is inclined to challenge the assumptions of his argument, the test lies in the fruitfulness of the argument in question.

"Any hypothesis must rest its case upon its capacity for explaining the phenomena with which it deals, in this case the phenomena of human action." The difficulty is that these are not all of the phenomena which need to be explained—at any rate, when we are considering the general problem of motivation. We must also account for "desire, feeling, will and purpose," as well as for the "compelling" character of these factors in "our immediate awareness." Even if these factors do not enter as links in physiological chains of events, they must still be linked in some manner with such chains. The present writer, like Allport, appeals to the reader to judge whether or not the succeeding presentation justifies the inclusion of the psychological phenomena in the attempt to develop a balanced psychophysical theory.

137. *The General Nature of the Psychophysical Relationship*

There is no need for any mysticism or vagueness in our conception of the relationship between physiological and mental factors, so long as we adhere to a strictly scientific standpoint. It is true that the metaphysical explanation of this relationship involves some very subtle considerations, but the practical method of handling the situation has long been at hand. It should indeed be self-evident that items of consciousness cannot form "links" in a physiological chain of events, since they fail entirely to fit into any such scheme. Nevertheless, we have absolutely convincing evidence that they have a law-abiding *correlation* with such physiological processes. All of this evidence substantiates the proposition that the introspective consciousness is a mathematical function of variables contained in and comprising the cortical synergy, which culminates what we have called the entegrative activity, and which consequently lies at the focus of active cortical adjustment.

It is quite impossible to conceive of consciousness as being in any sense *identified* with this neurological process, but no better or clearer scientific principle could be required than the one that these two systems have *correlated* structures and processes. Given one of these systems, we can infer the other if we know the laws which interconnect them. In the last analysis, such functional correlations are the foundations of all scientific reasoning. In purely physical thinking, we are also frequently able to *picture* the structural interrelationships of the terms which we are considering. However, in the case of the psychophysical relationship we can form no picture of the structural scheme. This fact is important, because it warns us against foolish attempts to interweave the psychical and the physical, by interpolating the psychical factors in the physical sequence; but it does not prevent us from handling the facts in a scientific manner.

Up to the present point in our analysis of the problem of motivation, we have been able to dispense with psychological conceptions without any great sacrifice of explanatory fruitfulness. This is largely because we have been dealing with phenomena which are observable in the behavior of lower animals, concerning whose psychological processes we are thoroughly ignorant. Our neglect of the psychological factors up to this point has had the further advantage of enabling us to develop certain physiological principles in an untrammeled manner, without either explicitly or implicitly introducing any subjective presuppositions. This places us in a position where we can formulate correlations with the psychical without danger of circularity of argument. We have now, however, reached a stage of our theory where it is advisable to bring in the subjective factors, if our doctrine is to have the widest possible explanatory value. The introduction of such factors should not necessitate any confusion between the psychological and the physiological groups of phenomena, but the theory of the two systems can best be developed from now on in parallel.

It is probably advisable, in the first place, to outline the general nature of *consciousness,* as we shall conceive it in our ensuing discussion. Consciousness, according to our conception, is the totality of any actual individual experience at any moment. It includes not only supposedly inner phenomena, such as feelings, imagination, thought, memory, and the like; but also external phenomena of sensation and perception. Consciousness is not a subtle, diaphanous entity or process, but is the system of concrete facts which is presented to each individual center of human observation. It embraces all of the objects of common sense, as well as the thoughts and feelings which concern these objects. It is a system of space relationships and factors in space, rather than primarily of so-called cognitive, affective or conative linkages. However, each individual has to be regarded as being strictly separate from all other similar systems, and we are unable to state what structural relationship obtains between any given consciousness and other such systems. We are also equally uninformed concerning the structural interconnections of any given consciousness and the cortical processes with which it is mathematically correlated. Very plausible conceptions of these interrelationships can be developed on a metaphysical plane of argument, but do not concern us in our present discussion.

It may seem from the above statement that our definition of consciousness makes it include physical as well as so-called mental facts. This is true insofar as portions of the physical system are regarded as actual phenomena. If colors and musical sounds are physical, then these physical things are also parts of consciousness; but it is to be noted that modern physical thought does not concern itself ultimately with phenomenal facts. It is interested, rather, in the supposedly permanent entities and processes which underlie such phenomena. It deals with electromagnetic waves rather than with color, with constellations of electrons and protons rather than with tactual solidity, with kinetic energy of molecular motion rather than with "cool" and "warm," and so on. Even on this basis, we might still claim that physical results are actually psychological, because in the last analysis the physicist can only demonstrate his own observations and his own thoughts concerning them.

Nevertheless, it may still be true that his thoughts signify the constitution and processes of a universe which lies altogether beyond the phenomenal consciousness. Although the complete validity of this proposition may be doubted on the metaphysical level of analysis, the interpretation which it represents is the best one for us to adopt in our present reasoning.

138. *The Analysis of Consciousness*

We may next consider the analysis of consciousness into components, and the general manner in which these components are correlated with the physically conceived nerve processes which we have already considered in so much detail. Consciousness as a whole possesses a coherence or unity which corresponds with that of the entegrative synergy in the cortex. Successive consciousnesses, forming the stream of a single individual experience, have a continuity in time which is paralleled by that of the changing pattern of excitation of the cortex in the region of focal activity. But, the consciousness at any moment possesses also an internal complexity which is an aspect of its specific structure and quality. We can describe the complexities of consciousness in two different ways: firstly, by treating it as a system of *parts* bearing definite structural relationships to one another and, secondly, as a combination of *attributes,* which have the nature of pure logical abstractions. Both of these methods of analysis can be applied simultaneously.

If we analyze consciousness into parts, we find that these may vary in magnitude and their own internal complexity. They also vary in kind: qualitatively or quantitatively. The parts of consciousness which psychologists usually distinguish are: perceptions, images and sensations. Sometimes conations, thoughts, and feelings (or affections) are also treated as structural components of consciousness. Other psychologists regard them as being attributive in character.

The most definite and probably the most important units of consciousness are perceptions or *percepts.* A percept, for the psychologist, is the same thing as an object, a situation, or an objective relationship or change, for the ideal common sense mind, a mind untainted by the sophistication of either physics or psychology. Percepts represent in consciousness the "things" to which we react. Their immediate correlatives, however, lie in certain sections of the cortical afferent synergy. In the writer's consciousness at the present moment there is a bookcase. In this bookcase there are many separable books. Either the bookcase or the individual books may be regarded as percepts. The bookcase-in-consciousness is not made up of electrons and protons—like the supposed physical bookcase—but rather of various shades of a color called brown, arranged in visual space before the empirical eyes. It also embodies some vague factors of a tactual and kinaesthetic sort. On top of the bookcase, there is another configuration of browns, which comprises a radio loud-speaker. The position of this latter percept in the writer's visual space corresponds approximately with that of certain musical tones and noises. The physicist asserts that this sound consists of waves in a molecular material known as air, which is supposed to intervene between the sound radiator and the listener; but as a part of consciousness they are something quite different, namely, auditory sensations.

Percepts, viewed as the representation in consciousness of "things to which we react," evidently cannot be restricted to apparent objects, such as bookcases, books, loud-speakers, etc. The musical tones may also constitute a percept, particularly when the tones and noises form intelligible words. The bookcase-before-me, which might be called a "situation," may also be said to constitute a percept. The loud-speaker-on-the-bookcase is another relational scheme of this sort, in which two or more separable object percepts combine into a more complex structure in a definite manner. We must also recognize percepts which involve *change,* such as would appear, for example, if the loud-speaker should fall from the top of the bookcase. However, all of these relational and process percepts are dependent upon object percepts for their substance.

Percepts, in turn, are supposed to be composed of *sensations*. Sensations are of many different kinds, and are usually regarded as being simple or unanalyzable; they are, so to speak, the bricks out of which all percepts, and hence, consciousness itself, are made up. Sensations differ from one another in several distinct ways. The most important way is probably that of *quality*, which is represented by such distinctions as those between different colors, between colors and odors, between "hot" and "cold," etc. There are many thousands of qualitatively variant sensations. Sensations also differ in *intensity*, ranging from very faint to very strong. When they have a very low intensity, they are sometimes called *images*, although this term is more frequently applied to particular combinations of such sensations to form faint counterparts of vivid perceptions. What is called *thought* usually consists of a sequence of imaginal factors of this kind.

Sensation and perception are ordinarily contrasted with imagination and thought by attributing the former to the action of objects or stimuli upon the sense-organs, whereas the latter are supposed to be due entirely to the spontaneous activity of the cortex. This is a practicable distinction from the psychophysical standpoint, but cannot be maintained from the purely introspective point of view, since imaginal factors do not differ inherently from the consequences of very faint sensory stimulation. However, we can see from the psychophysical point of view, that the distinction between the brain processes and their psychical accompaniments which are due to afferent excitation, and those which are essentially central in their causation, is a very important one. Nevertheless, psychological studies show clearly that the factor of central determination is very prominent also in all sensation and perception. If it is true that the totality of our consciousness depends directly only upon the cortical synergy, it follows that all of its characteristics are attributable to the brain, the relation to the sense-organs and to the physical environment being quite indirect. Pure sensation, in its most refined form, corresponds to nothing more peripheral than the unbiased reaction of cortical tissues to afferent nerve currents. However, in the adult cortex, this reaction is never actually unbiased, since it is affected by the records or traces of past afferently produced excitations. On the side of consciousness, we may say that there is always a factor of memory or recognition in any percept. Thus, consciousness corresponds at all times to a process which is the resultant of central and peripheral forces, although its inherent nature is always centrally determined. It follows that the perceptual world in consciousness may itself be strongly subject to forces of a motivational character, and can by no means be regarded as a neutral representation of the objective, physical scheme of things.

139. *Attention and Action*

One of the most important aspects of the structure of consciousness lies in what psychologists call *attention*. This relates to the fact that consciousness at any moment has a focalized constitution, within which certain percepts have a maximal clearness, while others are unclear or vague. We are usually said to be *attending* to the percepts which are maximally clear, but this is merely a definition of attention. The percepts which occupy the center of clearness at any moment represent the physical objects to which the organism is responding at that moment,—or, at any rate, to which it is set, on the afferent side of the cortex, to respond.

Just what happens when the *efferent* currents are released in the cortex, has been a topic of prolonged argument among psychologists. Some have claimed that there is a unique element called "will," "conation," or, possibly, an "innervation feeling," which characterizes the psychical scheme. However, it is to be noted that, since the organism is always responding in some fashion while consciousness persists, the conative element should be present constantly, and not merely arise from time to time when particularly significant changes occur in the character of the response. Modern studies have failed to identify the alleged "will" element in consciousness. They find the essential conscious condition for such changes in the response process to be attentional in character. The representation of bodily postures or movements in consciousness appears to be given exclusively in terms of so-called *kinaesthetic* images or perceptions. These are composed of kinaesthetic sensory constituents, which correspond to the effects of proprioceptive nerve currents upon the cortex. When a given kinaesthetic image dominates the clearness center of consciousness, the corresponding efferent innervation will always ensue.

Of course, we are not allowed to assume that the attentional change has any causal responsibility for the production of the cortical efferent innervation. However, the introspective phenomena suggest the probable nature of the cortical mechanism. We have supposed that consciousness as a whole is correlated with the pattern of the afferent-side activities of the cortex, but not with any details of the efferent-side neural organization. But the afferent side includes the proprioceptive excitations, which provide a detailed representation of all actually operative and many possible innervations. Furthermore, we have noted that each proprioceptive pattern will necessarily become associated with the corresponding innervation, because of the temporal contiguity of these two processes. The neurogram for any given proprioceptive excitation pattern, therefore, forms a natural medium for releasing the corresponding group of efferent impulses. Hence, we may well suppose that the act of attending to a given kinaesthetic image is the parallel in consciousness of the arousal of the corresponding proprioceptive neurogram, which will normally be followed by the associated innervations of the pyramidal neurones in the cortex and the naturally consequent motor reactions, or specific behavior. In terms of this theory, clearness in consciousness seems to be the psychophysical parallel of the adoption of the corresponding cortical record as a path of active conduction. A more fundamental view might identify the correlate of clearness with the degree of neural excitation at any point in the cortical synergy.

In the form of action which is known as "ideo-motor," movement seems to follow immediately from attention to non-kinaesthetic percepts. We see an object and react "without thinking" of what we intend to do. In this case, it would appear that the control of motor innervation has been transferred from the proprioceptive neurograms to visual ones, by a process which may be entirely analogous to that of the conditioning of a reflex or retroflex. If we suppose that the proprioceptive records are necessarily associated with the corresponding motor innervations, as a consequence of the circularity of the nervous arcs which are here involved, we can regard each one of these circuits as having the character of a reflex,—although we know that the circuits in question have been laid down entirely in consequence of individual "experience." If one of these proprioceptive circuits is associated with a "secondary" stimulus, the latter may eventually become capable, through some sort of short-circuiting [143] process, of setting off the innervations without operating through the proprioceptive neurograms.

It will be noted that consciousness, even in its volitional phases, offers only a very fragmentary representation of the total mechanism of response. However, it compensates for this imperfection, to a considerable extent, by providing us with a direct point of contact with the most crucial stage in the determination of the response. This point of junction between the afferent and the efferent impulses is not only of critical significance, but is, unfortunately, not subject to empirical examination by any present so-called objective methods. For these reasons, it will be very helpful if we can arrive at a satisfactory notion as to the relationship between the details of consciousness and those of the cortical adjustor mechanism.

140. *Theories of the Physiological Correlate of Affection*

Another aspect of consciousness which must probably be regarded as an attribute rather than as an element, and which has greatly interested students of motivation, is that which is known technically as *affection*. The term affection is used by the psychologist as a generic designation for *pleasantness* and *unpleasantness,* or the mode of variation of consciousness which they represent. Affection, in this sense, is to be distinguished definitely from particular concrete "pleasures" or "pains." Thus, what we ordinarily call pain is firstly a sensation and secondly, an *unpleasant* sensation, and affection is merely a property or attribute of the sensation. Pain may sometimes lack unpleasantness, or, at low intensities may even be pleasant. Similarly, lust is a sensation which is normally pleasant, but the pleasantness is not involved in its sensory character, and is to be regarded as an independently variable attribute. Affection is not restricted to simple sensations, but may be attached to perceptions, or to total consciousnesses.

The question as to the physiological significance of affection has been, and still is, a subject of indecisive controversy among psychologists. Three different classes of theories may be distinguished. They attempt to correlate affection, respectively, with sensory, central and motor processes. In the first group of theories we find, among other suggestions, the idea that affection is really a primitive sensation. According to one view, primitive animals have only two opposed sensory processes, one of which corresponds with movements of approach, and the other with movements of retreat. These are represented in the consciousness of the animal by pleasantness and unpleasantness, respectively. The progress of evolution has differentiated the receptive mechanisms, and the corresponding sensations, so that the higher organic forms possess a much more complicated sensory consciousness, but this continues to be presented against the background of the primitive sensory dualism, which constitutes the so-called affection. In this stage of development, the primitive sensations—being now of a vestigial character—are lacking in the clearness of more advanced psychophysical products.

According to another view, represented by Warren,[144] Boring, Nafe[145] and others, affection is introspectively reducible to a combination of certain organic sensations. Such sensations are difficult to separate and identify. Unpleasantness may correspond to vague organic pains, and pleasantness to the sensory processes which go with "well-being," sometimes known as coenaesthesia. It has also been asserted by Stumpf and Wooley [146] that pleasantness can be identified with the sexual sensations. The most recent view in this class—that of Nafe—identifies pleasantness, at least in part, with a "bright pressure," localized in the region of the chest, while unpleasantness is found to consist in a "dull pressure," which has an abdominal locus.

Among theories which try to relate affection to particular motor processes may be mentioned the view of Münsterberg,[147] who correlated pleasantness with extensor movements, and unpleasantness with flexor innervations. This theory is evidently based on observation of the normal muscular reactions to pain or pleasure. However, it might be pointed out that the sexual embrace involves very powerful flexions. Another interesting view is that of Holt,[148] which associates pleasantness with the harmonious alliance of efferent tendencies and unpleasantness with conflict or interference between them. This contrast is suggested quite clearly by Sherrington's studies of the interrelations of unit reflexes. Another obvious suggestion is that pleasantness goes with movements of approach and unpleasantness with those of retreat or flight.

However, the most hopeful place in which to look for the physiological correlate of affection is, obviously, the cerebral cortex. If we follow the usual psychophysical assumptions, it is necessary that the correlate in question should exist here, no matter what its associations may be with afferent or efferent processes. Nevertheless, the central theories of affection are distinctive in that they make the affection depend upon cortical processes which are relatively independent of peripheral causes, although not unaffected by the latter. A theory of this sort was advocated by Titchener [149] in his *Outline of Psychology,* where he suggested that pleasantness is correlated with anabolic, or constructive, chemical processes in the association areas of the cortex, while unpleasantness accompanies the opposite, or catabolic, type of chemical change. He supposed the anabolic processes to be conditional upon an ample supply of oxygenated blood, whereas the catabolic ones involve a scanty supply of oxygen. Marshall [150] elaborated a theory in accordance with which pleasure goes with brain activities which draw upon a store of reserve energy, while unpleasure is the accompaniment of an expenditure of energy which creates a neural deficit.

Miss Calkins [151] has advanced another similar doctrine, to the effect that "pleasantness and unpleasantness are occasioned by the excitation of fresh or fatigued cells in the frontal lobes of the brain, and this frontal lobe excitation is conveyed by fibres from the motor cells of the Rolandic area of the brain. When the cells of the frontal lobes, because of their well-nourished and unfatigued condition, react more adequately to the excitation which is conveyed to them from the Rolandic area, an experience of pleasantness occurs; when, on the other hand, the cells of the frontal lobe, because they are ill-nourished and exhausted, react inadequately to the excitation from the Rolandic area, then the affection is of unpleasantness; when, finally, the activity of the frontal lobe cells corresponds exactly to that of the excitation, the given experience is neither pleasant nor unpleasant, but indifferent."

Herrick [152] advocates the view that "the normal discharge of definitely elaborated nervous circuits, resulting in free unrestrained activity, is pleasurable. . . . Conversely, the impediment of such discharge, no matter what the occasion, results in a stasis in the nerve centers, the summation of stimuli, and the development of a situation of unrelieved nervous tension, which is unpleasant until the tension is relieved by the appropriate adaptive reaction." Herrick's theory suggests the general proposition that the *facilitation* of cortical conduction is accompanied by pleasantness, whereas inhibition of such activity results in unpleasantness. Vague biological or psychological doctrines of a similar nature had previously been advanced by Lipps,[153] Pikler,[154] and others. According to Lipps, pleasantness is a consequence of the harmonious and facilitative reception of a new tendency within consciousness, while unpleasantness results from conflict and relative inhibition of such a newly-entering tendency. Pikler's view assumes that organisms follow an inherent course of action, which may either be aided or opposed by temporary external forces, with consequent pleasure or displeasure, respectively.

141. *Meyer's Theory*

The most definite theory of this sort—and indeed the most definite of all extant psychophysiological accounts of affection—is that of Max Meyer.[155] Meyer reviews earlier doctrines and prefaces his own theory by a rather detailed sketch of what he supposes to be the fundamentals of the conduction processes in a complex nervous system. Although early in date, his ideas harmonize very well with those of Sherrington and other more modern students of the same subject. He regards the nervous system as an arrangement of converging sensory and diverging motor conductors, with numerous possible levels of transfer from afferent to efferent, in hierarchical order. Since consciousness occurs only in conjunction with the activities of the higher transfer levels or "centers," we must look for the correlate of pleasantness-unpleasantness in these latter centers. The "correlate of sensation is the nervous current itself," but "the correlate of pleasantness and unpleasantness is the increase or decrease of the intensity of a previously constant current if the increase or decrease is caused by a force acting at a point other than the point of sensory stimulation."

Meyer defends his theory against the possible objection that a mere increment or decrement in the "rate of flow" of the nerve current is too abstract a conception to form the basis of a psychophysical correlation, by showing that there is nothing logically inconsistent about such a doctrine, and by appealing to the facts about affection to support the implications which follow from it. He points out that it explains the inevitable dependency of pleasantness-unpleasantness upon sensation, as well as the impossibility of localizing affection in the sensory field and the non-existence of direct affective memory. He accounts for the correlation of pleasantness with certain sensations, and of unpleasantness with others, by indicating that such sensations have facilitative, or inhibitory influences, respectively, upon extant nerve conduction processes. Pain, for example, deflects the given conduction from its original course, the intensity of the accompanying unpleasantness being proportional to the "rate" of such "deflection," "which is identical with the rate at which the original flux is *decreased*." Sexual excitation, however, reinforces the conduction processes which are already going on.

The outstanding weakness of Meyer's theory from our present point of view lies in its failure to connect affection definitely with volition or action. He says: "According to our theory of their nervous correlate, pleasantness and unpleasantness cannot be regarded as causes of action in the sense in which sensations and ideas are causes of action." Nevertheless, he recognizes that his theory implies that on certain occasions, affection may be associated with critically important changes in conduction which may control the outcome of existing action tendencies. "However, those psychologists seem to have chosen the safer course who refrain from speaking of pleasantness as a cause of action. . . ." We should also note that Meyer disapproves of the view that pleasantness and unpleasantness are positive and negative phases respectively, of a single quality, quantity or variable.

Another conception, of quite a different sort, regarding the central conditions for the affective consciousness, is to be found in the writings of Henry Head[156] and his associates. Head's views are based upon his clinical and experimental studies of pathological changes in sensory and affective processes and their bodily "causes." He believes that the affective aspect of consciousness is correlated directly with the functions of the essential center of the thalamus, whereas sensory and intellectual factors are determined by the cerebral cortex. Although Head's evidence substantiates the idea that thalamic activities have at least a very important *indirect* correlation with the affective life, his special interpretation of the evidence in question appears to suffer from the difficulty of correlating certain unified psychical factors with anatomically separated physiological processes.

Chapter XVI

Doctrines of Psychological Hedonism

We have noted in our review of historic motivational theories that "pleasure and pain," or, to use technical psychological terms, affection, have frequently been supposed to play a very important part in the determination of human or animal conduct. The common sense individual seems to accept, as axiomatic, the principle that a conscious being will naturally seek the pleasant and avoid the unpleasant. A considerable number of psychologists, also, have adopted this principle in a wholehearted way. Thus, Spencer [157] felt obliged to assume it in his analysis of the evolution of mind; and James Ward [158] regarded feeling (affective experience) as the determining link between perception (cognition) and volition (conation). Other psychologists, however, have taken the opposite standpoint. Thus, McDougall,[159] representing a very mentalistic psychology, scores Freud for "taking over a fallacy which has long been current in popular psychology, and in the traditional associationist psychology of the utilitarian philosophy, namely, the fallacy known as psychological hedonism, the assumption that all human striving is fundamentally a striving for pleasure." Similarly, Watson,[160] representing an extreme behavioristic position, says: "It is our aim to combat the idea that pleasure or pain has anything to do with habit formation. . . . To call those stimuli pleasant to which the animal positively reacts, and unpleasant those to which he negatively reacts, is making a wholesale gratuitous assumption on a par exactly with the assumption made by the unreflective individuals who maintain that the moth flies into the candle because he likes the light, or because the light is pleasant to him." Titchener,[161] basing his statements upon experimental studies in the psychological laboratory, says that pleasantness and unpleasantness have nothing to do with the determination of action, which follows immediately from suggestion.

It is evident that such radical divergency of opinion requires an explanation. How is it possible that one group of thinkers, including such master minds as Epicurus, Hobbes, Bentham, J. S. Mill, and Spencer, as well as the "man in the street," should arrive at a view which is entirely repudiated by certain other very capable thinkers? Assuming both groups to be honestly minded, it would appear, either that they are not considering the same propositions, or that they are trying to explain entirely separate sets of facts. We shall find that both of these explanations hold good. One of the principal reasons for the conflict of opinion regarding the propositions of psychological hedonism lies in the fact that these propositions have seldom, if ever, been given an exact formulation. Consequently, the doctrine as a whole has been interpreted differently by different writers. Some interpretations may be consistent with certain facts, whereas others are inconsistent with all of the facts.

142. *The Ambiguities of Psychological Hedonism*

We have already mentioned one source of misunderstanding and confusion, with regard to the hedonistic theory which seems to be inexcusable. This consists in the failure to appreciate that the doctrine cannot imply, and hence does not depend for its validity upon, any principle of psychophysical interactionism. The majority of hedonistic philosophers have not been technically trained in psychology. They have formulated their views in popular language. However, this does not seem to constitute an adequate reason why psychologists should attack these views simply because the views seem to imply interactionism. When a physicist naïvely says that *blue* light will fog a photographic plate, we do not throw out his whole theory of exposure and the latent image because we know that "blue light" exists only as a visual sensation, and his statement implies interactionism.

It would therefore appear that the sensible procedure is to interpret hedonistic doctrines so that the alleged physiological influences of affection are attributed to its physiological correlate, and not to the affection itself. Thus, instead of saying that men or animals seek pleasure or avoid pain, we must affirm that they act so as to insure or avoid the physiological accompaniments of the respective affective phenomena. We are not necessarily compelled to deny that affective determination actually exists *within consciousness,* in accordance with principles of true causation, but between the psychical and the physical we must employ the parallelistic assumption, which necessitates the substitution of a physical or physiological concept for that of affection. If we use this method of reasoning, we shall not be worried, as are Perrin and Klein,[162] by the failure of existing principles "to demonstrate how a state of consciousness, such as unpleasantness, comes to modify the series of neuromuscular mechanisms which function in learning." We shall recognize, as a matter of course, that "a state of consciousness" certainly cannot "modify a series of neuromuscular mechanisms," but this is quite beside the point, the actual question being as to how cortical metabolism, or some other preferred correlate of the affective factor, accomplishes such modification.

Another difficulty with the usual formulations of the hedonistic principle lies in the failure on the part of the majority of hedonists, to provide a clear statement as to the supposed psychological relationships of affection and volition, particularly in regard to the *temporal* form of their alleged association. Bentham's dictum, according to which pleasure and pain are "our sovereign masters," may be taken to imply that we always chose the least painful, or the most pleasant, of all presented alternatives. However, he does not make entirely clear what these alternatives are, psychologically, and in what manner they are pleasant or unpleasant. The meaning seems to be that we choose those alternatives which we *believe will* yield the greatest pleasure or the least pain. However, at least when superficially considered, this principle appears to be intellectualistic rather than hedonistic; actual "pleasure or pain" are not necessarily involved, the essential determining factors being thoughts or images, which represent *anticipated* or expected affective consequences. Most of the attacks upon psychological hedonism appear to be directed against this kind of interpretation. Thus, we find Perrin and Klein saying:[163] "If the rat comes to eliminate a *cul de sac* because of its unpleasant consequences, we are forced to grant by implication that the animal not only sees the connection between the feeling and the blind alley which causes it, but actually remembers it. We have no evidence to support such inferences. . . ." The hedonistic theory is said to imply that "practically every retained act is retained because the organism is *aware* of the manner in which that act contributes to the resulting pleasure."

143. *The Temporal Classification of Hedonisms.*

The notion that volition is determined by anticipated pleasure may perhaps be formulated more exactly by saying that it makes *our present action a function of future affections.* However, even this proposition is not exact, since in many cases the anticipated affections are not "realized." In any event, future affection is certainly non-existent and unknown, so that it is only by the stretching of a logical classification that we can include this anticipation theory in the category of hedonistic doctrines at all. If we analyze its apparent psychological significance, we shall have to say that it endows judgments or the symbolic representations of probable affections with the power to determine volition. The actually operative principle would therefore seem to be a special kind of suggestibility, rather than a form of hedonism.

We might, however, ask the question as to how it happens that the symbolic representation of affective consequences is able to influence volition, and we might be inclined to answer that this is because such representations are in themselves pleasant or unpleasant. Thus, the *present anticipation* of future pleasure is pleasant, while that of pain is unpleasant. Possibly this correlation cannot be guaranteed to hold in all cases, but there certainly is a strong tendency in the indicated direction. It might therefore be suggested that the actual determinant of volition is the pleasantness or unpleasantness of the anticipation, rather than either its intellectual aspect or the supposed future facts which it represents. In this case, we should have a truly hedonistic doctrine, in accordance with which our choices are determined by certain affections of the present, rather than of the future.

This view can be expanded, so as to cover present factors of experience which differ from anticipatory judgments. It is by no means true, psychologically, that we are constantly governed by *thoughts* about what is going to happen some time hence. Most of the time, we are simply responding to sensory or perceptual presentations. A number of alternative kinaesthetic images, representing various possible forms of action, may present themselves without any accompanying depiction of their consequences. One or the other of these alternatives dominates the focus of consciousness and finds realization in the consequent behavior. We might, therefore, be led to assume, hedonistically, that the pleasantest of all of the presented alternatives will determine attention and, hence, volition. We act under the influence of "the pleasures of the moment." This Cyrenaic form of psychological hedonism has been formulated quite clearly by a number of utilitarian thinkers, although their preoccupation with the computation of future hedonic consequences has usually prevented them from developing its implications. In terms of this view, the rat does not avoid the blind alley because he believes that entering it will prove to be a disagreeable experience, but the sight of the alley together with the kinaesthetic image of entering, which it suggests, are inherently unpleasant and are, therefore, thrust out of consciousness. According to this view, the center of consciousness has an attractive action upon pleasant presentations in proportion to the degree of their pleasantness, and a correspondingly graded repulsive action upon unpleasant presentations. Hence, if a logical judgment anticipating unpleasure happened, paradoxically, to be inherently pleasant, nothing could save the mind from accepting this judgment, with its consequences in action. Cases of this sort are, of course, very common in everyday life, where we frequently adopt a course of action which we know will lead to unpleasant results. This is because the immediate representations of these lines of behavior are pleasant.

We have thus considered two forms of psychological hedonism, which may be described as *hedonism of the future* and *hedonism of the present,* respectively. The former doctrine is hedonistic only by courtesy, because it renders volition a function of non-existent, or imaginary, affective values; and, as ordinarily conceived, in no way guarantees that the realized future will correspond to its anticipatory representation, which is the supposed controlling factor. However, we seem to have neglected a very important section of time, namely, the *past.* This, also, has the disadvantage of being non-existent, but compensates for this defect by being perfectly well-determined and fairly well-known. Moreover, we are quite in the habit of looking for the causes of present events in the past. Hence, if we were constructing a hedonism *de novo,* it would seem natural, rather than otherwise, to place the affective determinants of our volition in past time. We may note, also, that anticipations of the future are usually based upon experiences of the past, so that verbal representations of hedonic consequences should probably be regarded as effects rather than as causes.

Hedonism of the past appears to have had no very outspoken or clear-thinking apostles, although there are numerous doctrines in the literature which can be interpreted along this line. Among these is Thorndike's original "law of effect," as well as the general idea that a rat avoids a blind alley because he *remembers* that it caused him discomfort the last time he entered it. It is not difficult to substantiate the view that the anticipation of pleasantness or unpleasantness is usually nothing more than a disguised memory of experiences similar to those which are anticipated. Thus, we may be said to shrink from a visit to the dentist's, not actually because of the pain which is in store for us, but because of that which we suffered at the last visit. If it were not for past experiences, either of our own or other people, we should have no basis at all for definite anticipations. However, a hedonism of the past need not be formulated so to require "memory" of an intellectual, or even of a pictorial sort. It would be a mistake to limit such an hedonism by requiring that past pleasantness and unpleasantness can only be effective upon present volition through the medium of thought or imagery. Thorndike's view provides us with a formula which does not suffer from this restriction. The animal is not required to *recall* anything, in order that he should profit by his past experiences of pleasure or unpleasure. He merely finds an increased tendency to act or to choose certain kinaesthetically represented alternativs, because of their previous association with pleasure, or the release from unpleasure. However, this view is, of course, not inconsistent with the presence of definite memories, on certain occasions, or even of intellectual judgments regarding past affections, especially in the human instance.

A hedonism, exclusively of the *present,* must restrict itself to instantaneous states or processes and consequently does not face the problem of the influence of *duration* upon hedonistic determination. However, either a hedonism of the future or of the past, must distinguish between instantaneous intensities of pleasantness or unpleasantness and the time during which they endure. Enlightened anticipation must consider the duration, as well as the intensity of an expected affective experience. Thorndike's law of effect certainly implies a quantitative integration of intensities and durations. Thus, he says that "the greater the satisfaction or discomfort, the greater the strengthening or weakening of the bond," while the "law of exercise" demands that "any response to a situation will, other things being equal, be more strongly connected with the situation in proportion to the number of times it has been connected with that situation, and to the average vigor and duration of the connections." Psychologists, as a rule, are not prone to exact mathematical formulation, but Thorndike's scheme clearly suggests the proposition that the tendency for a response to recur *is proportional to the time integral of the affective intensity* taken over the entire lifetime of the individual, for the given form of specific response. This proposition automatically takes care of all factors of intensity, duration, and algebraic sign.

144. *The Psychological Properties of Affection*

Before continuing further in our study of possible interpretations of psychological hedonism, we must arrive at a somewhat more distinct idea concerning the psychological nature of affection. We must first choose between the two general alternatives of regarding affection either as sensory or non-sensory character. In this matter, we shall adhere to the views of Max Meyer and others, according to which affection or pleasantness-unpleasantness is non-sensory in nature. This position may be taken to imply at least two distinct propositions: first, that affection is of a different nature, introspectively, from the class of psychical elements which are ordinarily designated as sensations; and, second, that there is no fixed and limiting relationship between affection and the excitation of particular receptors. This last proposition does not mean that certain forms of receptor or afferent nerve excitation may not show definite correlations with affective experience, but merely that the correlation is frequently low, variable, and not restricted to particular afferent channels or to afferent channels as a class.

In spite of modern studies which report the existence of certain definite sensory accompaniments of positive and negative affection in laboratory experiments, it seems impossible to accept the proposed identification of affection with particular sensations. "Bright pressure" in the thoracic region does not seem to be any more satisfactory as an equivalent of pleasantness than does the sexual sensation, as advocated by Stumpf and Wooley. Introspection certainly does not confirm with the idea that "bright pressure" must accompany sexual sensation in order that the latter should be pleasant or, on the other hand, that the usual pleasantness of "sweet" is due to associated erotic feeling. In the case of unpleasantness, pain sensation is certainly a very promising candidate to represent the affection sensorially. It is not, however, actually any more acceptable than is "dull abdominal pressure," since it is easy to find plenty of unpleasant experiences which exhibit neither of these accompaniments. The writer, therefore, feels confident that all attempts to reduce affection to definite sensory constituents will prove futile, and that the attribution of such experiences to processes having essentially central conditions is necessary for the development of a useful and lasting doctrine.

The next question is as to whether affection is an element, an attribute, or a process, from the introspective standpoint. If it is an element, it should be capable of standing alone, without requiring any other elements or group of elements as a support. If it is a process, it must exhibit change as an essential to its existence. Attributes are incapable of existing alone, and *inhere* in elements, groups of elements, or in processes. Thus, intensity or quality are attributes because they must be intensities or qualities *of* something else. The almost universally accepted notion among psychologists that affection requires a sensory, perceptual, or imaginal foundation clearly suggests that it is attributive in character. Although affection is unstable and liable to change, nevertheless it is easily conceived as constant over some finite span of time, so that we are not justified in viewing it as a process. The introspective examination of affection also shows that it is not—at least psychologically—a process. Consequently, we shall regard it as being an attribute, inhering in any other component of experience which circumstances may indicate. Thus, we may find: affective sensations, affective perceptions, affective images, etc. The entire consciousness may be, and usually is, affective as a whole. We shall never find a pure pleasantness or unpleasantness in isolation from definite conscious contents of a non-affective sort. A pure or floating "affect" in the Freudian sense is impossible. However, this does not mean that affectivity necessarily attaches in a specific and invariable way to particular mental contents, but only that *some* such content is always requisite.

Another old-time controversy, with regard to which we must take sides, is that as to the quantitative nature of affection. Here, we shall adopt the familiar view that affection can be measured as if it were an algebraic variable. Pleasantness is not the mere absence of unpleasantness, nor is unpleasantness a simple lack of pleasantness. The "indifferent" condition is recognizable, absolutely, without reference to particular values of positive or negative affection. The latter vary, ideally, in a continuous manner—plus and minus—with respect to the indifference point, which is regarded as zero. Thus, pleasantness can be treated as positive affection of a certain intensity, and unpleasantness as negative affection having a definite negative value. If we use this method of conception, we do not have to distinguish constantly between pleasantness and unpleasantness, but may speak generally of affection or *affective intensity*—the measure of affection at any instant—which may have either positive, negative or zero values. The usual conventions of algebraic calculus will apply to this conception. Thus, an increase of positive affection is the equivalent of a decrease of negative affection; equal positive and negative values cancel, etc. The use of these mathematical conventions will greatly simplify the development of any theory into which affection enters; and if such a theory leads to consistent results in harmony with the facts, this is a sufficient justification of the mathematical conventions upon which it is founded.

When we treat affection, or affective intensity, in this manner as a quantity, we are, of course, doing so in accordance with the usual interpretation of what is meant by a psychological quantity. When we say that affectivity is a quantity, we simply mean that affective perceptions, ideas, consciousness, experiences, etc., can be arranged into a series in which the members vary progressively in the manner which we designate as affective. The measure of affectivity is, in reality, merely a designation of the *position* of the given psychical term in a series of this sort which has been provided with a definite numerical *scale*. Affectivity is entirely analogous in this respect to hue or saturation in the case of colors. Such concepts are actually defined with reference to conceptual arrangements of psychical terms, rather than being the determinants of such arrangements. We find it possible to compare factors of experience in particular ways, and thus to develop classifications based upon specific modes of intercomparison. Regarded in this way as an attribute, affectivity is simple and irreducible, and is definable only by exhibition in instances of concrete experience.

For purposes of computation, as well as general clearness of conception, it is desirable to distinguish definitely between characteristics of consciousness which are instantaneous, or are independent of temporal duration, and those which involve a finite span of time. We may distinguish generally between *consciousness* as an instantaneous affair, and *experience* as a temporal succession of consciousness. As thus defined, an experience has a beginning and an end in time, but any consciousness is an instantaneous snapshot. Although it may seem that this makes consciousness a very ephemeral thing compared with experience, it should be noted that the only portion of experience which actually exists is the present consciousness which, strictly speaking, is without duration, although it moves continuously along the time line. Now the measure of the affectivity of any *consciousness*, as thus technically defined, may be called the *affective intensity* of the consciousness, or portion of consciousness, in question, this measure being an algebraic quantity having the properties previously discussed. In general, this quantity may be expected to change as a function of time, and the function will have definite characteristics for any given section of experience, the latter being regarded as a sequence of consciousnesses. Any such experience will also have a definite affective value, which will involve the duration as well as the intensity of the affection. As a measure of this, we may take the time integral of the affective intensity between the two temporal limits of the given experience. We may designate such an integral quantity as an amount of affection. It obviously involves the dimension of time, as well as that of affective intensity, and is an algebraic quantity.

The question as to the exact units in terms of which affection shall be evaluated does not concern us vitally in the present discussion, since we shall have no occasion to deal in exact quantities. However, it would be in accordance with usual psychological procedure to adopt the "just noticeable difference," or differential limen, as a unit for the measurement of affective intensity. Amount of affection would then be measured in terms of limen-seconds. Other affective units, such as the pathedon and pathedon-second of James Mackaye, have been proposed.

145. *The Retroflex Correlations of Affection*

Let us now return to a consideration of the problem of psychological hedonism. Our method of attack upon this problem will be that of a further study of the most probable physiological correlate for affective intensity. The evidence which we need to consider comprises, on the one hand, the views regarding the mechanism of response and of learning which have been presented in previous chapters and, on the other hand, the psychological facts concerning the relations of affection and other aspects of experience in everyday life. We shall do well, in the beginning, not to lay much stress upon results obtained in the psychological laboratory where the conditions of affective experience are usually highly specialized.

Although we have distinguished very definitely between affection and other components of consciousness, we nevertheless find that there are definite correlations between affection and certain other forms of experience. Perhaps the most striking relationship of this sort exists between affective intensity and certain sensations. Thus, pains are nearly always unpleasant, and the degrees of their unpleasantness tend to be proportional to their sensory intensities. This does not permit us to identify the affectivity with sensation, because sometimes we experience pains which are indifferent, or even pleasant. An itch, for example, is a pleasant pain. In addition to pain, we find the following sensations to be characteristically unpleasant; hunger; thirst; gustatory bitter, sour and salt, above a certain intensity; the olfactory sensations which are classified as alliaceous, caprillic, repugnant, and nauseating; coolness, when not preceded by undue warmth; a prolonged warmth above a certain intensity; the feeling of nausea; the desire to micturate; the desire to defecate; and unrequited sexual desire. All of these sensations are here conceived as psychical qualities, forming portions of consciousness, and out of relation to any particular receptive system, or excitations thereof. On the side of pleasantness, we note a correlation with the following classes of sensations: lust, or sexual feeling, above a certain intensity; gustatory salt and sour below a certain intensity; gustatory sweetness; moderate degrees of warmth; coolness when preceded by undue warmth; the olfactory sensations which are classed as ethereal, aromatic and balsamic; sensations following defecation and urination; the feeling of bodily well-being (coenaesthesia); and the feeling of drowsiness.

It will be noted at once that the above classification of sensations with respect to their ordinary affective accompaniments corresponds, almost exactly, to that of the parallel receptive systems as beneceptive or nociceptive. Consequently, it is also paralleled by the division of retroflex functions which we have assigned to these particular receptive channels. We cannot be accused rightly of circularity of argument in this connection, since we have taken particular care to avoid any logical implication of psychological phenomena, in our definition of the physiological characteristics which are here concerned. Nevertheless, the accuracy or degree of the correlation is very striking, so much so that it should imbue us at once with a great respect for Spencerian principles; according to which pleasantness must be associated with beneficial, and unpleasantness with injurious, biological conditions.

We may generalize our findings, in our own terminology, by saying that affective intensity shows a high degree of positive correlation with beneception-nociception. It will be noted that the correlation is not restricted to a mere classification of receptive channels, but operates within a single such channel in harmony with the beneceptive-nociceptive aspects of the receptive function, which may vary with such factors as time or intensity. Thus, a low stimulation of the salt-sensitive receptors of the mouth is beneceptive and is paralleled by a pleasant taste, whereas a higher intensity excitation of the same receptors is nociceptive and is accompanied by an unpleasant gustatory sensation. Similarly, coolness is disagreeable and has a nociceptive significance, except when preceded by undue warmth, in which case it is pleasant and beneceptive. Of course, the classifications as beneceptive or nociceptive have no direct physiological meaning, and are based upon considerations as to average biological utilities. Consequently, their correlations with affective intensity do not provide us with an immediate psychophysical relationship.

However the retroflex process falls into an entirely different category, because it is supposed to be an actual physiological activity which has been developed by evolution in accordance with the dictates of the biological situation. We have been led to our conception of this process, not only because it seems to be needed as a basis for the control and development of specific response, but also because it provides a satisfactory explanation for these effects. If we regard retroflex action as a single quantitative variable, having positive and negative values, our psychophysical observations lead us tentatively to the formula: *Affective intensity is proportional to retroflex action.*

146. *Affectivity in Relation to Conductance Changes in General*

However, it is easy to arrive at a more penetrating analysis of this relationship. We have defined retroflex action as a mechanism and process by which the conductance of cortical adjustors is raised or lowered, and for our present purposes we may identify it with the intrinsic change in such conductances. On this basis, we can infer that *affective intensity is proportional to the rate of change of cortical adjustor conductances at any moment.* It will be noted that both affective intensity and a rate of change are algebraic variables having possible negative, zero and positive values. To those who are unfamiliar with the principles of the calculus, it may be pointed out that a change which is decreasing the value of any variable is conventionally designated as negative, whereas an increasing change is positive. A zero value of the rate of change, of course, signifies a static or unchanging condition of the given quantity, which in our case is the adjustor conductance.

It will be perceived that this conclusion bears a notable similarity to the hypothesis which has been advanced by Max Meyer. We cannot, however, reduce it to an exact correspondence with Meyer's assumption without robbing it of most of its explanatory value. The variable which Meyer conceives to increase, or decrease, in correlation with affection, is the conduc*tion* rather than the conduc*tance.* These two words may sound alike, but their physiological meanings are entirely distinct, although not unrelated. Conduction is the term for the momentary process or action which goes on in a nerve circuit, whereas conductance is the name of a *permanent characteristic* of this circuit which enables it to conduct. More exactly, the conductance is a quantitative measure of such conductional ability. The relationship between these two factors is expressed generally by means of Ohm's law—to which we have already adverted—and according to which the conduction is proportional to the pressure (or impelling force) multiplied by the conductance. Hence, given a certain pressure, the conduction will vary as the conductance, but the conductance will not necessarily change in general as a function of the conduction. Although Meyer is not very explicit on this point, it would appear that he attributes the changes in conduction, which are referred to in his theory, to alterations of pressure rather than of conductance. However, we can regard his postulate as a corollary of our own, under the special conditions that the pressure remains constant and the conductance changes, when the conduction will follow suit.

The most serious objection to Meyer's view, as we have previously indicated, lies in the fact that it has no very clear implications regarding *learning*. This is exactly the respect in which our present postulate proves to be most fruitful.

The next step in our reasoning will be to see whether we cannot expand our applications of the above psychophysical doctrine regarding affective intensity somewhat further. The idea that affective intensity is proportional to the rate of change of the conductance may be broader than simply to say that it is correlated with retroflex action, since there are other possible conditions for such conductance changes. It is apparent, at once, that we can extend the principle to cover secondary, tertiary, and other derived retroflex processes. The law of exercise, according to which a response tendency increases with mere use, must also be interpreted as necessitating a conductance increase. The law of decay or disuse, similarly, demands a decrease of conductance with the lapse of time. Other conditions, under which adjustor conductances change, will probably be found. For example, an interference of cortical adjustments with one another will involve inhibition and, very likely, conductance decreases; whereas the alliance of such adjustments may be expected to bring about special conductance increases. These are probably to be regarded as complex cases of the law of exercise. Special metabolic or chemical conditions, such as insufficiency of oxygen supply, or the presence of narcotics, or other drugs (e.g., strychnine) in the blood stream may also affect the adjustor conductances, bringing about positive or negative changes therein. Let us suppose the principle which correlates affective intensity with the rate of change of adjustor conductances to be a perfectly general one, regardless of the particular cause which may operate to bring about the conductance changes at any particular time in any particular case. In other words, we may regard this principle as expressing a true psychophysical correlation, and if it has this status the exact manner of physiological determination of the cortical process will have no bearing upon the accompaniments in consciousness. The affectivity would be just the same if these causes were entirely absent, but the given adjustor processes were maintained.

Chapter XVII

A Definite Hedonism of the Past

The psychophysical doctrine which we have developed in the preceding chapter, and which correlates affective intensity with the rate of change of cortical adjustor conductances, has a number of very important and interesting logical consequences. Because of the definite nature of our assumptions, the deduction of these consequences can be carried out by strictly mathematical methods; and in order to make our argument as clear cut as possible it will be necessary to use some mathematical symbolism. However, for the benefit of the reader who may not be versed in such methods, or finds them to be unduly fatiguing, we shall also elaborate the implications of our doctrine in a more discursive manner. The outcome will be the development of a definite form of psychological hedonism—a "hedonism of the past"—which will prove to be very useful in the understanding of motivation from the psychological and psychophysical standpoints. It will offer the following advantages: (1) consistency not only with all of the facts which have hitherto been used to support hedonism, but also with those which have been employed in arguments against it; (2) furnishing a foundation for a systematic account of motivation as a purely psychological process; and (3) the establishment of a definite correspondence between the psychological and the physiological explanations of action.

147. *Mathematical Development of Our Hedonistic Theory*

Let us consider, first, the mathematical formulation of our psychophysical postulate. If we let c stand for the conductance of the cortical adjustor which is operative at any time, t, and if we let a symbolize the affective intensity at the same instant, we can write

$$(1) \qquad a = k\frac{dc}{dt},$$

where k is a constant of proportionality. The expression, $\frac{dc}{dt}$, is the usual one for "the rate of change of c with respect to t," or, as it is called in calculus, the first derivative of c with respect to t. The numerator, dc, symbolizes a very small change in conductance, which occurs during the very short (infinitesimal) span of time represented by the denominator, dt. It will be noted that the algebraic aspects of the relationship which is expressed in equation (1) are taken care of automatically. If the conductance is increasing, the expression, $\frac{dc}{dt}$, will be positive, so that the value of a must also be positive, or the affection will be pleasant. On the other hand, if the conductance is decreasing, the sign of $\frac{dc}{dt}$, will be negative, so that the affection must be unpleasant. If there is no change, $\frac{dc}{dt}$ will equal zero, and the affective intensity will have the same value, corresponding to "indifference." The entire theory is thus comprised in a very small logical "nutshell," from which, however, an elaborate growth of inferences can arise, as we shall proceed to demonstrate.

But before passing to these deductions it may be advisable to dilate to some extent upon the conditions which determine the truth of equation (1). In the first place, it should be understood clearly that the conductance, c, is that of the cortical adjustor or group of adjustors which enter into the focus of cortical conduction at the given moment, t; and the processes of which are directly correlated with the introspective consciousness. Conductances and conductance changes occurring elsewhere in the nervous system do not have the slightest degree of representation in this equation. They are as if non-existent. What is happening in the spinal cord, the medulla, the thalamus, or in other cortical areas, has no significance except insofar as such processes may help to determine the nature of the cortical synergic activity through purely physiological influences. Secondly, our equation represents the state of affairs at a *mathematical instant;* the time, t. Consequently, on the psychological side, it applies to a *consciousness,* as we have technically defined this conception, and not to an *experience.* Those who are familiar with the definition of a "time derivative" will recognize that it refers to a *rate* which exists instantaneously, and requires no finite time span for its definition. Since a single consciousness and the corresponding phase of the cortical mechanism comprise no finite amount of time, there is no actual modification in conductance within them. Such modification requires the passage of time, or the generation of a finite experience span.

However, our fundamental equation provides us with a logical basis for determining the affective properties and relationships of an *experience,* regarded as a psychical system having finite duration. In order to ascertain these facts, we may have recourse to the mathematical operation known as *integration,* which can be applied to our equation (1), because the latter can be converted into an equation of the so-called *differential* type. In this form, it becomes:

$$a\,dt = k\,dc, \qquad (2)$$

or, integrating,

$$\int a\,dt = \int k\,dc, \qquad (3)$$

or, following the usual rules of the integral calculus,

$$\int a\,dt = kc + b, \qquad (4)$$

where b is the usual "constant of integration." The significance of b will be considered below.

The expression, $\int a\,dt$, is known as "the time integral of a." It represents a particular kind of summation of affective intensities over the total time span of the experience which is being considered. It is actually a measure of what we have previously defined as an "amount of affection," involving a unit of time as well as of affective intensity. If we conceived the affective intensity to remain constant throughout the experience which we are studying, we could determine its amount of affection by a simple multiplication of the measure of such intensity by the duration in seconds (or any other convenient unit of time). This arithmetical product would be exactly equal to the expression, $\int a\,dt$. However, if the affective intensity varies from one instant to another during the period of time in question, we cannot evaluate the amount of affection in this simple way, although the actual value will still be representable by an area, having affective intensity and time as its two determining dimensions, as illustrated in Fig. 3b. The expression, $\int a\,dt$, is a convenient means for symbolizing the value of such an area, regardless of its exact form.

The expression in question has, however, certain other important properties. Amount of affection may be either positive or negative, according as the values of affective intensity during the given experience are representable by plus or minus quantities, respectively. The process of evaluating an integral, such as $\int a\,dt$, operates so as to yield the *difference* between all of the positive and all of the negative amounts of affection, or other variable, occurring during the time interval which is involved. This difference may obviously be either positive or negative, according as pleasantness or unpleasantness, respectively, predominate. Hence, the integral represents the algebraic rather than the arithmetic summation of the affective aspects of the experience. In Fig. 3b the areas below the time line must be added together and subtracted as a whole from the sum of the areas above the line, to yield a value corresponding to $\int a\,dt$.

$\int a\, dt$, or amount of affection, may be identified with the popular conception of "happiness." The term, happiness, is usually employed in such a manner as to imply temporal properties or duration. Happiness is regarded as being an *enduring* pleasantness; or unhappiness as con-

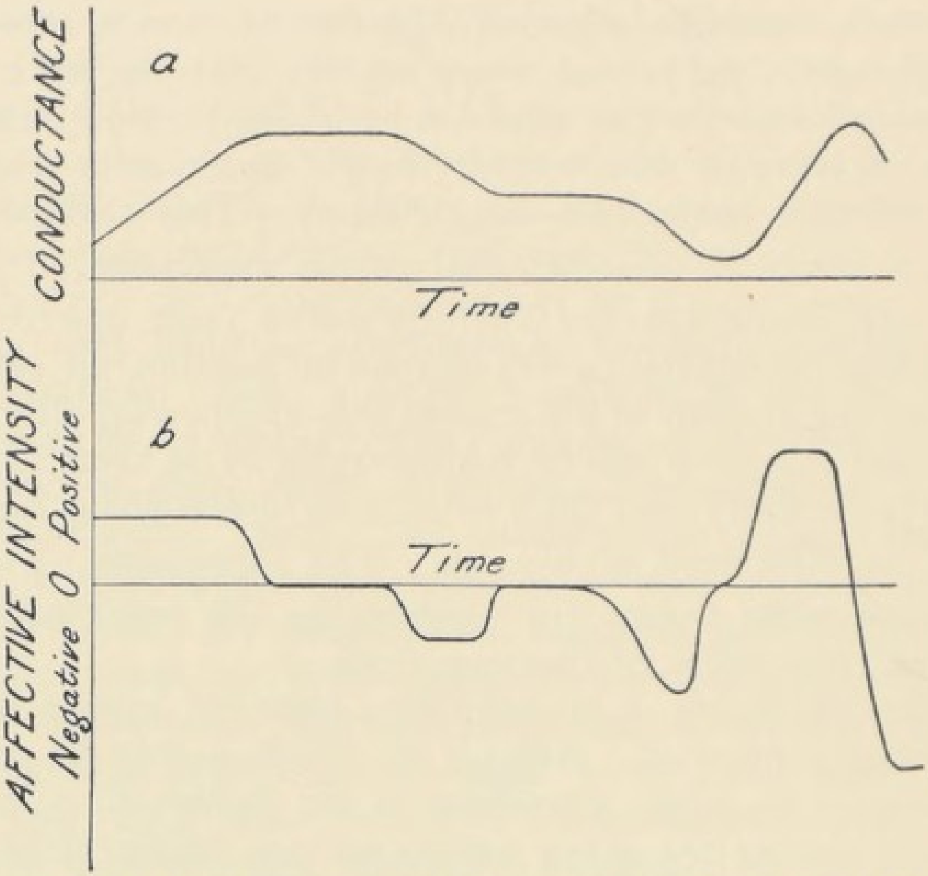

FIG. 3. THE RELATION OF AFFECTIVE INTENSITY TO CONDUCTANCE CHANGES.

The two curves show corresponding events or conditions in time. The upper curve, *a*, represents an imaginary cortical conductance history, while the lower one, *b*, delineates the accompanying affective intensities in consciousness. It will be noted that the values of the lower curve are proportional to the *slope* of the upper curve at the same instant in time.

stituting a persistent unpleasantness. Happiness is measured by James Mackaye in "pathedon-seconds," rather than in "pathedons." Now, $\int a\, dt$, may be said to represent the sum of all of the happiness minus the sum of all of the unhappiness comprised in the given experience; or it may be said to symbolize the resultant, or net amount of, happiness. If this quantity turns out to be negative, we may either call it *un*happiness, or may be content to designate it as negative happiness, treating happiness as an algebraic quantity in the usual manner.

The significance of the right-hand side of the equation, which involves physiological rather than psychological terms, may now be considered. The term, c, represents the conductance of the cortical adjustor or adjustors at the end of the experience. However, the entire expression, $kc + b$, stands for the positive or negative change (increment or decrement) in conductance which has occurred during the period in question. This change is equal to the difference between the initial and the terminal conductances. Since c stands for the terminal value, we can set $b = -kc_0$, where c_0 is the initial value. The right-hand side of equation (4) then becomes: $k(c - c_0)$. Now, if the initial conductance happened to be zero, this expression would obviously reduce to kc, the total conductance of the adjustor at the end of the experience having been acquired during the period of the latter. However, cases of initial zero conductance must be very rare, and the conductance change will not necessarily be positive in direction, so that a knowledge of c_0 is essential to a complete determination of the expression. The essence of the psychophysical relationship which is expressed by equation (4) may therefore be reduced to:

$$(5) \qquad \int a\ dt = k\ \triangle c,$$

where $\triangle c$ represents a finite increment or decrement in the conductance.

Now, if we limit the duration of the experience, which we have considered in the above analysis, to that which corresponds to the use of a single cortical adjustor—mediating an individual specific response—the conductance change, $\triangle c$, will apply to this single adjustor only. The change in conductance will be proportional to the total amount of affection which has been experienced during the given interval, and in conjunction with the operation of this particular adjustor. If, at a later time, the same adjustor comes into play again, the total amount of affection during the second experience will be added algebraically to that of the first one, with a corresponding combination of the conductance changes for the two periods. In this way, if we add up, or "integrate" the total amount of affective experience which has occurred in conjunction with any particular adjustor through the lifetime of the organism, we shall have a quantity which is proportional to the total augmentation of the conductances of such an adjustor during the same period. Consequently, the integral amount of affection can be regarded as an index of the tendency for the given adjustor to function. If we consider all existing or possible adjustors in this manner, we shall find that their conductance values are represented in the same way by the respective affective integrals, and consequently if we desire to know what adjustor will operate in any given situation—involving theoretical alternatives—we have only to ascertain which adjustor has had associated with it the greatest summation of affection,—because this one will also have accumulated the greatest positive conductance. This is true, of course, only true on the assumption that the initial conductances of all adjustors were the same. This assumption must be approximately correct, if we believe that the cortex has no appreciable inborn conductive bias.

148. *A Non-Mathematical Exposition*

A less mathematical exposition of the above ideas can be offered in the form of an analogy. Suppose that we compare the competing adjustors to motor cars in a race. Their several conductances will be represented by their positions on the track, measured back to the starting point at any instant; and their "rates of change of conductance" will correspond to their respective speeds in miles per hour. The affective intensities which correspond to each moving car may be identified with the readings of the speedometers on the several dashboards. It will be noted that the speedometer reading is a perfectly static quantity which is nevertheless proportional to a dynamic quantity, or rate, as is the case in the relationship between the rate of change of adjustor conductance and affective intensity. Now, it should be obvious that the winner of the automobile race will be the car which runs the longest time at the highest average speedometer reading. However, to make the comparison exact, we must imagine a race on a track which will only accommodate one car at a time; one car being allowed to make as much progress as it can over a certain period of time, and then another car entering—ordinarily at a different position on the track—and progressing over a restricted interval. Thus, the position of any given car on the track—or with respect to it—at any time will be determined by the juxtaposition of a series of runs, and its total progress will be greater the longer and the faster these runs have been. Drivers of the cars could ascertain their respective positions from a knowledge of the times of running, and the exact course of the speedometer readings throughout these intervals, without having any view of the track or other information from the outside. This is the analogue of our prediction of volitional or response tendencies on the basis of specific affective histories.

In order to make the automobile race analogy perfect, however, we must suppose that the cars are likely under some circumstances to run backwards, or to retrogress on the track (corresponding to a reduction of conductance), and that in this case the speedometers read backwards—less than zero—in negative miles per hour. Moreover, we must suppose that the cars all start together on a line at the beginning of the race. If, for any reason, a car is given a handicap, we should have to know its exact starting position with respect to that of the other cars, in order to be able to compute its position from a mere knowledge of driving periods and speeds. This consideration evidently corresponds to the possibility that the conductances of the alternative cortical adjustors are not absolutely equal, at the beginning of mundane individual experience. In an actual race, no two cars could actually start from exactly the same position (say, accurately to a thousandth of an inch), but small differences at the beginning would prove to be irrelevant in the end. Similarly, slight variations of initial cortical conductance, such as may suffice to control random behavior, may be entirely submerged for all practical purposes by the accumulated effects of subsequent experience. It will be noted that the position of any automobile on the race track, in our analogy, merely represents the *availability* of the corresponding cortical adjustor for the mediation of response, provided the appropriate stimulus is present.

149. *The Kind of Hedonism Which Our Theory Implies*

It would appear that our analysis, up to the present point, has at least sufficed to establish a certain form of psychological hedonism—definite hedonism of the past—according to which response tendencies are proportional to the total amount of affection which has been experienced in connection with any given form of response during the lifetime of the individual organism. In other words, from the psychological standpoint, the *historical basis of reacting* is to be found in the integration of past happinesses. Habit is rooted in past pleasures or displeasures. Learning by experience, psychologically, means automatically basing one's preferences upon the affective teachings of the past. It will be perceived at once that this form of hedonism is entirely consistent with the present choice of an alternative which at the given moment may be less pleasant than other competing possibilities.

Another way of stating the facts from the purely psychological standpoint is as follows. If we were strictly limited to the introspective data of any moment, we should be unable to predict the course of conscious choices or volitions. Action would appear to have no adequate causal determination. Of course, we could still prophesy the response from the physiological standpoint, using our knowledge of the relative conductance values of the various possible lines of cortical adjustment which were capable of operating in the given situation. But all of this would be hidden from the introspective standpoint. We might say, however, that the actual choice of alternatives which appears on the introspective side is referable to certain definite *preferences* on the part of the given individual mind. These show some degree of permanency or reliability from one time to another. Each alternative might be said to possess a definite *preference value* or *preferability,* the one with the highest value of this sort predominating.

The question would now arise as to the psychological basis, if any, of such preferabilities. Our theory implies that such a basis could be found exclusively on the psychological side of the equation, in the affective histories of the volitional alternatives. Each of these alternatives, representing a particular association of perceptual and kinaesthetic (virtually, motor innervational) factors, may be considered to have an individual affective history, and to have accumulated a definite value of $\int a\,dt$ (or amount of affection) during the total time span of this history. The alternative having the highest value of this sort could be predicted to predominate over the other alternatives. The *basis of preference* would therefore be found in the comparative values of integrated past affections for the various volitional alternatives. *This evidently provides us with a comprehensive, strictly psychological, theory of motivation.*

It should be clear that this kind of hedonism of the past does not necessarily make any requirements upon memory or judgment, in the ordinary meaning of these terms. It is not necessary, in order that the individual should choose, now, the line of conduct which has given him the greatest pleasure or the least displeasure in the past, that he should *remember* these facts. Our theory demands that the choice of the alternatives which has given him the greatest happiness in the past should be established by this fact in itself, without reference to memory in the ordinary sense. If there is any actual memory of the accumulated affective experience, it lies in the strength of the volitional impulse, alone. However, there is no reason why, as a side development, there may not be an imaginal, mnemonic, representation of the fact that a certain form of conduct has yielded pleasure or displeasure, as the case may be. Nevertheless, this type of memory would presumably have little bearing upon the volitional outcome. It would be a redundancy of the second order to suppose that in addition to memory, there should be required a judgment, such as that "what has given pleasure in the past will do so in the future, and hence shall be chosen."

150. *Relation to Other Forms of Hedonism*

As we have previously suggested, however, our hedonistic doctrine is capable of explaining the facts which support the usual hedonisms of the present and of the future. The forms of volition which have yielded the greatest pleasantness in the past will have a considerable probability of doing so again in the present or the future. It is to be supposed that there will be some degree of constancy in the conditions which cause certain forms of volition to yield pleasantness and others to yield unpleasantness. These conditions may be partly environmental and partly intraorganic. In the case of a pleasantness or unpleasantness which is referable to the conditioning of a retroflex tendency, a considerable reliability is to be anticipated. Where the conditions involve some particular arrangement of things in the environment, sudden changes are liable to occur. The principle of affective adaptation—according to which the pleasantness or unpleasantness of particular forms of experience tends to decay with repetition—may also operate to break up the correlation between the past and present—or future—affective fruitfulnesses. Consequently, our theory leads us to expect just about what we find in everyday experience.

If we consider the mechanism of a hedonism of the present to lie essentially in the fact that images, attention to which results in action, tend to be selected in proportion to their inherent affective intensities, the case is somewhat as follows. Volition or action may follow from attention to either kinaesthetic or non-kinaesthetic images, and the latter may be components in perceptions of objects, relations, etc., constituting portions of the external world, as presented in consciousness. According to our view, such motor attention is due, psychophysically, to the high conductance of the corresponding cortical adjustor. It is the representation, in consciousness, of the passage of the nerve current from the afferent to the efferent sector of the cortical arc. Now, if such a dynamogenic image is pleasant, this is because the corresponding adjustor conductance is increasing and if this increase has persisted over any finite span of time, however short, the dynamogenic tendency will have been correspondingly augmented.

When we speak loosely of "present pleasures," we usually imply an appreciable span of time and not merely a mathematical instant, such as we have conceived in our theoretical analysis. At any rate, it would be impossible actually to find a pleasantness or unpleasantness which is strictly non-enduring. The affective intensity of the present moment is continuous with that of immediately preceding and succeeding instants. But why should the conductance be changing? The most likely answer is that this is due to the action of a primary, or of a derived, retroflex process, which is operating either to enhance or to depress the given action tendency. Insofar as this retroflex action is powerful and persistent, it will tend to determine the decision among alternatives in the given volitional situation. However, this is said simply by way of explaining the cases to which a hedonism of the present seems actually to apply; and it leaves plenty of room for the exceptions to such a doctrine.

We have already seen that hedonism of the future is essentially an intellectualistic doctrine. We mean by this statement that it involves thoughts and meanings, rather than feeling or impulse. Future affections, as represented by present thoughts, are the supposed determinants of volition, in accordance with the usual hedonistic theory. It is supposed that the higher the amount of affection which a proposition *means,* the more likely this proposition is to be adopted as a basis for action. This kind of doctrine evidently involves us in a series of very subtle psychological problems. In the first place, we have to understand how thought is related to volition. Secondly, we must know how thought can symbolize affection, and particularly future affection. Thirdly, we must answer the question as to how symbolized non-existent affection can determine action through the complex medium of the thought which refers to it. A complete analysis of this relationship would lead us into arguments which belong to a later portion of this book.

Nevertheless, we may suggest a brief outline of the explanation at the present point. It is evident that thought or language can symbolize pure affectivity. Otherwise, we should be unable to discuss it intelligibly, as we are endeavoring to do now. However, in everyday life our thoughts are concerned for the most part with feelings, or combinations of particular sensations, perceptions, images, etc., with affection to form pleasant or unpleasant "things." Such "things" ordinarily have affective value because of their correlation with primary, or with derived retroflex processes. The thoughts about them acquire an affectivity by a further associative transfer of this sort. Such thoughts must, therefore, correspond with a neurological process which has acquired the capacity to inhibit, or to facilitate cortical adjustments, and in this way to exercise a control over the course of response. As a parallel of this control on the psychological side, we find the thought governing the volitional process, encouraging certain imaged alternatives and discouraging others. If this were the whole explanation, it would follow that such influence of thought upon volition should invariably be accompanied by a present pleasantness or unpleasantness, and reduce to a special complicated case of hedonism of the present (as interpreted in accordance with our hedonism of the past). This will certainly apply to the very first experience in which such governing thoughts play a part. However, if, as is usually the case, the thoughts are more or less habitual in their relation to particular stimuli, most of the affectivity may really lie in the dim past, and the thoughts will merely represent regular components of the total complex adjustor activity, the real foundation of which is historical.

The problem of intellectualized hedonism is one which we shall consider in detail in concluding chapters. The scientific control of human action in the interests of the greatest happiness inevitably relates to the future; because past and present affective experience is beyond control, or, at least, beyond the possibility of remedial improvement. How is it possible for us to adopt future happiness as the predominating motive of intelligently regulated life if, psychologically, our sole motive lies in the happiness of the past. Now, it is clear that we do not act *for* the past, but only *because* of it. It is equally evident, that even if we act for the future, we *cannot* act because of the future. Action on behalf of the future must be determined by the past. We must avoid giving the idea of motive a double meaning. For the psychologist or physiologist a motive must be a cause, but for popular thought it is usualy an effect.

One very general treatment of this situation is as follows. If we experiment with that kind of cortical adjustment, or action, which consists in *planning or choosing scientifically in the interests of future happiness,* we shall thereby accumulate in connection with this form of adjustment a greater value of $\int a\,dt$ than could probably be summated in any other possible manner. This is because scientific planning will inevitably yield a larger amount of happiness than will unenlightened behavior. The accumulation of affection will be greater, the more precise and reliable the scientific control. Hence, we should expect the habit of rational planning for the future to develop a very high conductance value, so that eventually it might dominate other action tendencies. We should thus find ourselves automatically regulating our action in accordance with this principle, not because we receive any real inspiration from the future, but because the past has confirmed us in this attitude.

Of course, the development of such an advanced form of action tendency would require a considerable amount of experience, and hence should not be expected to exist in a youthful psychophysical organism, but rather to appear in proportion to age—possibly becoming most marked at an age where its utility for the future is at a minimum. These expectations are borne out by a study of human behavior and thought at various ages. Initial trials of the scientific planning type of response, have, of course, to be developed by a purely random mechanism in isolated individuals and are obliged to compete with other alternative lines of response. Their only chance of being adopted under such circumstances would lie in a possible quick fruitfulness, or in the severity of the punishment which might be administered, in the state of nature, for other types of response. However, in the social situation, the scientific method is explicitly taught and enforced by artificial rewards and punishments, so that in the environment which is afforded by civilization, the individual who fails to develop a certain amount of intelligent foresight, is subjected to harsh penalties. It is characteristic of the progress of civilization to accumulate, and forcibly to transmit to posterity such habits of planning for the future.

Such critics as McDougall would probably refuse to class the doctrine which we have developed in the present chapter as a form of psychological hedonism. McDougall [164] identifies psychological hedonism with what we have called "hedonism of the future," and distinguishes between this doctrine and "hedonism of the present," which he defines quite clearly, although without designating it by this name. He fails entirely to consider in this discussion any view which might be identified with our "hedonism of the past." Bentham's dictum [165] was that "on the occasion of every act he exercises every human being is led to pursue that line of conduct which, according to his view of the case, taken by him at the moment, will be in the highest degree contributory to his own greatest happiness," whereas hedonism of the present is expressed by J. S. Mill's[166] affirmation that "to desire anything except in proportion as the idea of it is pleasant is a physical impossibility." The objections which are raised by McDougall to hedonisms of the future and of the present, appear not to apply to our hedonism of the past, which leads us to expect exactly the kind of facts which McDougall himself appeals to in his argument against the hedonistic doctrines. It is, of course, of little consequence whether or not we classify our "hedonism of the past" as a form of "psychological hedonism," although it certainly must be regarded as a theory which makes volition a function of affection. Our hedonism of the past seems to have exactly the form which is required if we are to assert that our action-choices are *effects* of pleasantness or unpleasantness, acting as *causes,* since we are accustomed to place true or "efficient" causes in the past, or prior in time to their effects. Psychological hedonism, as defined by McDougall and others, is actually a teleological theory, involving a doctrine of so-called "final" causes, which cannot be regarded as lying within the pale of scientific views, unless it is definitely reinterpreted.

However, it is to be noted that McDougall does not shun hedonistic doctrines entirely. Both in his *Introduction to Social Psychology*[167] and in his *Outline of Psychology,*[168] he expresses a principle which is very close to our own, when he says that although pleasure and pain in themselves are not springs of action they nevertheless "serve to modify instinctive processes, pleasure tending to sustain and prolong any mode of action, pain to cut it short; under their prompting and guidance are effected those modifications and adaptations of the instinctive bodily movements which we have considered." Again: "Pleasure sustains, prolongs, and confirms the modes of striving which bring pleasure, that is, successful modes. Pain or displeasure, on the other hand, checks us, discourages and turns us aside from the line of effort we are pursuing now, or have pursued unsuccessfully in the past. To this fundamental feature of its nature, the mind owes its directive power, its power to guide and improve our modes of striving towards our goals." Evidently, however, judging from the slight attention which he pays to the application of these principles, McDougall does not really regard them as of basic importance.

Chapter XVIII

The Pleasures of Novelty and Their Correlations

Apart from prejudice or suggestion, it is a common persuasion among men that the personal importance of an experience *per se* is measured by its affectivity. Life is "good" or "worth living" in proportion to its pleasantness; or it is serious or disheartening in proportion to its unpleasantness. Prolonged happiness makes men value life intensely, whereas sustained misery frequently leads them to suicide. Intense affective experiences, such as severe bodily pain or sexual desire, dominate our entire outlook on life, and seem to constitute ultimate sources of inward motivation. Sentimental thinkers have constantly striven to express life in terms of emotions, and even intellectualists have been determined in the forms of their intellectualism by their feelings. McDougall, while branding psychological hedonism as a fallacy, nevertheless refers to "its power to hold the allegiance of those who have once accepted it . . ." which is "explained by the fact that it seems to afford a rational explanation of all conduct, to show a sufficient cause for all action. Whenever an action can be regarded as an effort in pursuit of pleasure, or in avoidance of pain, we seem to have an explanation which is ultimate and intelligible. We feel no need to inquire: Why should anyone prefer pleasure to pain, or seek to gain pleasure and to avoid pain? No other theory of the ground of action seems at first sight so self-evident and satisfying."

This fundamentally satisfying character of the hedonistic view is to be attributed to the fact that all of our present choices are actually determined by our past affective experiences, and we implicitly or subconsciously recognize the harmony of the hedonistic doctrine with this fact. Since it is our thesis that the roots of motivation within the mind lie in affective experience, we shall do well to review the principal forms of such experience, in the light of the hedonistic theory which we have developed in the preceding chapter.

In accordance with these teachings, the affective intensity of any consciousness is proportional to the rate of change of the conductance of the then operative cortical adjustors. We have seen that such conductance changes may be due to either primary or derived retroflex action, to the laws of exercise or of disuse, and to other more accidental causes. Although we have developed our physiological account of motivation up to the present point, primarily on the basis of the doctrine of retroflex action, our affective psychophysiology is much broader than are the implications of retroflex theory. The retroflex device is simply one very important condition for conductance changes; but any conductance change whatsoever must have an affective correlate in consciousness.

151. *The Pleasantness of Novelty and the Principle of Use*

The simplest condition for *increase* in conductance lies in the so-called *principle of exercise or "use,"* according to which the mere passage of a nervous current through a group of cortical conductors augments their conductance or conductances. We cannot be certain as to the exact physiological nature or limits of such conductance changes. From the behavioristic standpoint, any modification in the response tendencies of the individual must be supposed to depend upon, or, indeed, may be said to constitute, a conductance change. If it can be shown that the modification occurs in the region of the cortex which is correlated with the introspective consciousness, we should expect to find a corresponding affectivity. Ordinarily, the conductance will be one which associates incoming with outgoing nerve processes.

However, in certain cases, it may be confined to the afferent side of the cortical activity, or mechanism. This should be the case for simple sensory impression upon the cortex, which may not appear to have any explicit consequences in behavior at the time when the impression is formed. However, at some later time, behavior may be found to differ because of the presence of this impression. We have seen that the most probable correlate for the introspective consciousness consists in the sensory-side activities of the cortex, so that we should expect conductance changes of this essentially afferent character to have strong affective correlates in the introspective field.

Now, it is our view that each new grouping or pattern of afferent processes, at the focus of activity in the cortex, lays down a characteristic system of conductances in the form of a sensory *neurogram*. Each such neurogram is functionally individual with respect to any other neurogram, although anatomically they are undoubtedly overlapping. Their formation must depend in part upon the establishment of conductances along channels which are perpendicular to the main line of nervous conduction. "New" neurograms are not formed by *each* successive pattern of afferent currents, but only by patterns which differ from one another in an adequate and sufficient manner. Thus, "exactly similar" afferent patterns would always arouse the same neurogram, increasing its conductance up to a certain limiting value, but not creating individually distinct impressions. Even when the patterns are not "exactly" similar, they may merely rearouse an "old" neurogram, if their departure from the form of the latter is only slight, or occurs along certain restricted lines. When an identical neurogram is rearoused, there may be a judgment that we perceive, imagine or think of "the same thing."

Now, the formation and conductance increase of such distinct neurograms is accompanied in consciousness by a pleasantness which is proportional to the total rate of conductance increase at any instant. We assume in our present discussion that no retroflex mechanisms, either positive or negative, are operative. The neurographic conductance increase is attributable solely to the principle of exercise or to the permanent, or semi-permanent, opening up of conduction paths as a direct consequence of excitation. In accordance with the ordinary curve of saturation, which has been found experimentally to apply to the laying down of such memory records, we should expect the rate of conductance increase to be rapid in the early stages of formation of a neurogram, falling off gradually until it reaches a practically zero value when the conductance arrives at a certain limiting magnitude, which represents the maximum attainable perfection of memory. Consequently, the affective intensities which accompany the first sensory or perceptual experiences corresponding to any given object, situation or event should have a higher positive value than will later similar experiences, and eventually the affectivity will be reduced to zero. Subsequent repetitions of the experience will be indifferently affective. The affectivity in this case, therefore, depends upon some degree of *novelty*. (See Fig. 4.)

These principles may be taken to account for a very large class of human pleasures, which are conditional primarily upon the newness of the given experiences. Pleasures of this sort are, of course, more characteristic of youth than of a more advanced age. As soon as a child reaches a phase of cortical maturity where he can begin to receive complex impressions, a vast array of possibilities is immediately opened to him. The whole world of sense and ideas is "his oyster"; he has only to devour it cortically, although this may require a long time. Thereupon, he proceeds, through semi-random activity, to try everything at least once, building up his knowledge of the world and the world of knowledge, as he goes. At first, the impressions are of a relatively simple sensory character; later they correspond to definite objects, including persons; situations, involving groups of objects, are subsequently recorded; then come classes of things, and words to stand for the classes; combinations of words follow: scientific principles, operations, systems, purposes, and perhaps a view of the universe as a whole. As the individual advances, the neurographic records increase in intricacy and may form hierarchical structures in which relatively simple records form portions of arrangements of a higher order. As time goes on, the possibility of novelty among the simpler forms decreases, so that novelty must now be sought in more complex con-

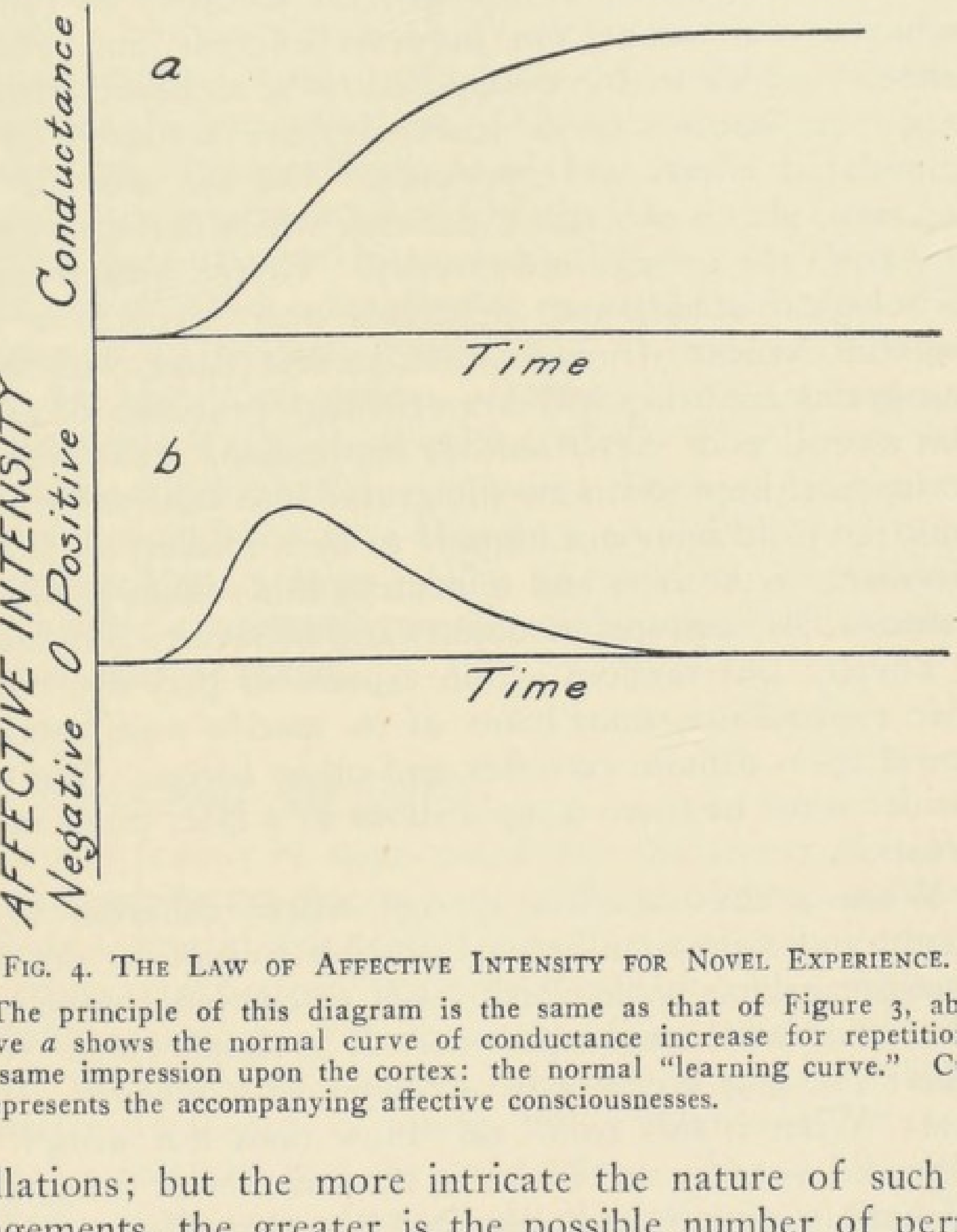

Fig. 4. The Law of Affective Intensity for Novel Experience.

The principle of this diagram is the same as that of Figure 3, above. Curve *a* shows the normal curve of conductance increase for repetition of the same impression upon the cortex: the normal "learning curve." Curve *b* represents the accompanying affective consciousnesses.

stellations; but the more intricate the nature of such arrangements, the greater is the possible number of permutations, so that the possibilities are infinite for a nervous organism which can continue to progress in learning. But any perception or idea which is repeated sufficiently will pall affectively.

152. *Play and Curiosity*

The pleasure which is taken by children in novel experience is associated with the type of behavior which we call "play," and with the impulse which is known as *curiosity*. Viewed from the standpoint of response as a whole, play is largely an expression of the general tendency to random conduction—or connection between afferent and efferent channels—which we have supposed to be a characteristic of the cortex, insofar as its tendencies are unbiased by the accumulated effects of experience. On the side of consciousness, play is pleasant experience which derives its affectivity from the principle of novelty. Viewed thus from the psychological standpoint, children's play involves a very powerful element of imagination, in accordance with which neurograms are being laid down through processes of association as well as of direct sensory impression. However, the two types of impression are integrated into coherent wholes. Thus, the child imagines himself to be a soldier, an Indian, a fireman, or the like, and reinforces these ideas by the aid of supposedly appropriate objects and behavior. Of course, the novelty and random action aspects of play are not its entire explanation, since many of its specific manifestations depend upon definite retroflex and other forces. We shall consider some of these complications at a later point in our discussion.

When a child reaches an age where coherent verbal thought and expression become possible to him, he develops a question-asking habit which leads to continual novelty of verbal or of intellectual experience. If he simply says: "What is this?" he gets a new word or name as a reward. If he asks: "What is this for?" or "How does this work?" or "Why did you do that?" he is rewarded with a so-called explanation, or a more complicated verbal pattern, which can be integrated with the given stimulating perception or sensation. A new environment offers a wealth of entertainment for the child in this stage of development. Every unfamiliar object must be viewed, moved, and made the object of interrogations. If it has a use or a manner of operation, it must be "tried." This same kind of experience continues in adult life, but usually in more complicated form and limited by the influence of retroflex forces, which direct response along biologically useful lines. In study, research, and in business, we constantly gain pleasure from the acquisition of new ideas, new facts, new principles, or new methods of work. In these phases of life, the novelty effect is nearly always combined with a retroflexly determined component, but is none the less important. When the shop-keeper opens his new store he is thrilled; as is the scientist when he discovers a new phenomenon. The thrill is greater the more complex the system of ideas, or the greater the "apperceptional mass," which is involved in the total integration. The pleasure is particularly great when a *problem* is solved. Here an incomplete group of ideas finds a complement which rounds it out into a unified whole. The conductance increments which physiologically underlie these processes are naturally of an integrative character, since they appertain to the so-called entegration section of the cortical mechanism, and involve cross-conductional combinations of otherwise isolated afferent paths.

153. *Amusements and Sports*

It will readily be appreciated that the factor of novelty is a very important determinant of the pleasantness of many popular forms of amusement or entertainment. Although numerous retroflex or "instinctive" tendencies are appealed to at the same time, these would be inadequate by themselves to supply the required degree of pleasure. Theatrical performances of nearly every kind make a fundamental appeal to the novelty motive. This is confessed explicitly in the case of the so-called "variety" or vaudeville presentation, and is particularly evident in its close relative, the musical *revue*. Even in the case of the drama, the same factor is of importance, although here, there is usually a special appeal to more fundamental emotional forces. However, very few people care to see a drama more than once, although the first presentation may have been highly pleasing. Music, particularly of the "popular" type, depends largely for its pleasure-giving power upon novelty, losing its affective fruitfulness rapidly with repetition. The more complex, or "classical" music will stand more repetition because of its greater intricacy, especially for persons who are trained in a knowledge of musical forms. Similar propositions obviously apply to short stories, novels, and other means of literary entertainment.

Games of all sorts, using cards, balls and other objects, whose behavior is difficult to control and predict, derive much of their interest from the novelties which they make possible. The factor of competition is also of fundamental importance, of course, but less so when one merely witnesses the game, without participating in it. A game like chess or like football can be played an indefinite number of times without ever following the same course. Travel, whether by rail, water or automobile, also affords a constantly changing series of impressions, with continuous novelty, if the environment is new. The modern interest in radiotelephony derives a great deal of impetus from novelty, not only because of the general newness of the system, but because of the great variety of auditory stimuli which it brings into environments which may otherwise be quite monotonous. In the case of the radio experimenter, there is a continuous possibility of new observations, effects, and discoveries in consequence of the complexity of radio apparatus and principles. It must, of course, be recognized at the same time, that radio appeals to many other fundamental motives, particularly those which are associated with the "ego complex."

Variety is thus truly "the spice of life."

154. *A Novelty as a Motivative Force*

It is apparent that certain aspects of our above discussion imply that novelty, as a general characteristic of experience, apart from particular forms of response which will be novel only in the beginning, can become a motivating force. In other words, we can develop a habit of seeking experiences which are new and different, a tendency of response which is highly suggestive of what is ordinarily called *curiosity,* although frequently we interpret curiosity narrowly as a question-asking or problem-solving effort. Now, so far as the primary implications of our hedonistic theory are concerned, we should not expect the individual to embark upon a quest for novel experience, as such, even if novelty regularly yields pleasure. We should anticipate, rather, that the pleasure which accompanies any new experience would bring about a continuation of the given form of response, so that, before long, the pleasantness would disappear as a consequence of repetition, while, at the same time, the given response would continuously be strengthened. Hence the pleasantness of initial experiences should tend to establish fixed habits which would seem to be inconsistent with the generation of a supposed quest for novelty.

We know from direct experience, however, that novelty *does* become a motive in itself, and presumably because of its capacity to yield continued pleasure; so that we must needs explain the mechanism of this process. In seeking for such an explanation, we might appeal in the first instance to the basic random movement tendency of the cerebral cortex, which will persist and overcome habit formations which do not possess a sufficiently high conductance value to insure them against the disturbing action of this fluctuating agency or condition. However, a more advanced mechanism, based upon experience rather than directly upon hereditary action tendencies, is required to account for all of the phenomena. We must regard variety-seeking as a separate form of cortical adjustment, which coöperates with particular, more specific adjustments in such a manner as to regulate the latter in the interests of variation of stimuli rather than of the fixation of response. The quest for variety is not necessarily inconsistent with such fixation, since specific fixed responses are aroused only when their appropriate stimuli are present; whereas the variety motive is a quest for new stimuli: a kind of *Reizhunger*. It is not a part of any particular habit, no matter how well-formed it may be, that it should involve a quest for its own stimuli. The quest for stimuli is a property of appetitions, or certain kinds of habit-formers. The existence of a habit merely means that *if* the stimuli appear, due to any cause or accident, the typical response will follow.

Consequently, the variety motive simply involves the formation of a tendency to seek stimuli which are different from those which have been met in the past. This kind of adjustment must arise, like all others which are acquired during the individual lifetime, as a consequence of some random conjunction of cortical units which is reinforced or increased in conductance, either retroflexly or in some other manner. Now, the quest for new stimuli has biological value because it widens the organism's chances of winning a livelihood, and also of propagating its kind. However, if we were to try to account for the development of the variety motive on the basis of a supposed hereditary retroflex mechanism, we should be compelled to give the latter a form quite different from that which we have assigned to other retroflex systems. A more plausible explanation lies in the supposition that the novelty-seeking adjustor is augmented in conductance purely through its association with the initial phases of each new form of cortical impression. The stimulus to the novelty-seeking response would naturally be the absence of novelty, or the presence of familiar sensory excitations. The quest for novelty would operate as an appetition that is reinforced, or made into a habit, by the actual discovery of novelty, which is supposed to act in the same manner in this particular case as do positive retroflexes in general.

In order to account for such a "stamping in," or conductance increase of the novelty-seeking adjustor, we may assume that the conductance increase which normally accompanies the "discovered," specific novel excitation is shared by all associated adjustors. This is in harmony with the notion that the totality of all simultaneously operative cortical adjustments forms an integral system, which is subject to conductance changes as a whole rather than in parts. It corresponds with the observed fact, on the psychological side, that the affective attribute appertains essentially to consciousness in its entirety, rather than to a restricted portion thereof, and that so-called mixed feelings (simultaneously presenting pleasantness and unpleasantness) are impossible, or extremely rare. However, we are apparently compelled to suppose that the association between the novelty adjustor and any specific afferent pattern exists essentially only via the aspect of the latter which represents its novelty. Consequently, this association will operate with respect to any novel constellation of sensory impulses, regardless of its other characteristics.

These requirements seem to be rather intricate and special, but psychological observations assure us that relationships of the required sort are possible. The word, "novelty," cannot have the meaning which it is intended to possess, unless the particular cortical neurogram which corresponds to this word can be aroused by differential aspects of afferent excitation rather than by their concrete forms. Introspectively, we observe that it is possible to adopt the pleasure of variety as a motive, either after the plan of the ordinary hedonism of the future, or that of a simple habit. The establishment of a general variety response would depend upon principles similar to those which operate in certain less general cases. The practical quest for novelty usually becomes habituated along certain specific lines. Thus, we form habits of going to the theatre, of taking automobile rides, of playing cards, golf, etc., to a large extent, apparently, because of the variety of experiences which they customarily yield. Although important contributions are made to all of these habits by retroflex agencies, it would, nevertheless, appear that their principal foundations lie in their actual ability to yield a variety of new experiences within restricted domains. The facts of everyday life certainly indicate that, apart from all retroflex influences, we definitely form habits which favor the production and maintenance of any relation to our environment which can supply a preponderance of novelty in sensory stimulation.

Such observations would appear to imply a general principle of *affective transfer* or diffusion according to which, on the physiological side, changes of cortical conductance, no matter how conditioned, tend to operate in the same sense and degree with respect to all simultaneously involved cortical adjustments. As previously noted, this principle may be regarded as an aspect of the integrative, or redintegrative character of the central-afferent processes.

One consequence of the above reasoning is that we should be able to explain the phenomena which are associated with the so-called instinct of curiosity, without recourse to a special hereditary mechanism. This does not mean that certain aspects of behavior which are ordinarily attributed to curiosity are lacking in an hereditary basis. The purely random activity aspect of "play" is to be referred largely to the congenital cortical adjustment instability. We have also seen that variation of reaction is likewise a characteristic of appetitional or "instinctive" behavior in general. We have even suggested that there may be a very comprehensive appetition, which is aroused by the unduly prolonged or repeated action of any particular stimulus. If such a tendency actually exists as an hereditary endowment, it comes very close to providing us with a congenital basis for curiosity response. However, this mechanism would operate only as a defence against undue "stamping in" by exercise, and could not be relied upon to bring about the active and prompt switching from one stimulus to another which characterizes the amusement-seeking reactions.

155. *The Novelty Principle in Habit Formation*

We have, thus far, considered only the *afferent* aspects of the phenomena which are related to the formation of new impressions upon the cortical tissues. In order to generate a *habit,* there must be an opening up of conductances from afferent to efferent, or a definite linking together of incoming and outgoing nerve currents. Now, as we have seen, the afferent currents can be divided into two classes according as they are proprioceptive or non-proprioceptive, respectively. The proprioceptive impulses represent the motor reactions of the organism in sensory terms, and naturally sustain a definite relationship to the motor innervations at any moment. The non-proprioceptive impulses stand for conditions external to the organism, or for internal conditions of a non-motor kind. Ordinarily, a specific response involves the linkage of non-proprioceptive with efferent nerve currents in some definite manner. Now, evidently, the question arises as to whether this linkage is direct, or whether it occurs through the medium of proprioceptive factors. In all probability we shall be forced to admit the possibility of both forms of connection, but there are certain facts which suggest that the indirect linkage, via a proprioceptive neurogram, is the first kind to be established in the process of learning.

On the psychological side, we find that in forms of action consciousness which are relatively new or unpracticed, an external perception must arouse an appropriate kinaesthetic image before specific volition is possible. Repetition of the given kind of action may cause the kinaesthetic image to disappear from the process, so that the action seems to follow directly from attention to the external perception. On the physiological side, we find that paralysis of the proprioceptive channels interferes so seriously with the cortical regulation of muscular processes that coördinated response becomes virtually impossible. Consequently, it seems quite likely that the initial event in the establishment of the majority of advanced responses consists in the "cross-conductional" association of the appropriate proprioceptive neurogram with a given non-proprioceptive impression, to yield an integral record. This could only occur, however, when the required motor adjustment has already been executed at least once, so that its neurographic representation is present, and is linked directly with the proper efferent innervations. The increase of conductance which is necessary for the establishment of a habit under these conditions will evidently be entirely of the cross-conductional, or sensory impression type, and the pleasantness of the corresponding consciousness must be attributed solely to this process.

In other cases, however, we shall be compelled to deal directly with the formation of plain afferent-to-efferent linkages. This process must certainly be involved in every case where a given form of motor innervation occurs for the *first* time, and also in the establishment of connections between proprioceptive images and the corresponding innervations. In many cases, particularly in youthful organisms, the required movement will appear first as a random consequence of non-proprioceptive excitation, and the proprioceptive process will intervene a moment later and combine with the already present pattern of conduction. Until we find evidence to the contrary, we may suppose that all of these conductance increases contribute to the affectivity of the corresponding consciousness.

Our theory of retroflex action, as previously presented, has been expressed primarily in terms of direct afferent to efferent conductance, rather than of the cross-conductional variety. However, if the formation of specific responses depends to any extent upon the association of proprioceptive and non-proprioceptive neurograms, we shall probably be compelled to include this form of conduction among the process which are subject to retroflex influence. But we cannot extend this influence so that it applies generally to all sensory recording upon the cortex, since doing so would necessitate that unpleasant experiences should entail the destruction of sensory memories. This is, of course, contrary to the facts, in spite of the familiar phenomena of lapses of memory and perception which are attributed by Freud to unpleasant associations. We shall discuss the explanations of these effects at a later point. It would be fatal, from a biological standpoint, for nociceptive excitation to interfere with the recording of the stimulus situation under which such excitation occurs, since the extension of the inhibitory effect in this way would make it impossible for the organism to learn to avoid the dangerous objects or conditions which are responsible for the nociceptive process. The *conditioning* of negative retroflex mechanisms would also be stopped by such interference with sensory recording. There is no biological objection, however, to the *facilitation* of the process of afferent impression through positive retroflex action.

156. *Affective Consequences of the Principle of Disuse*

The principle of exercise has a companion in the *principle of disuse,* according to which conductances tend to decay, or to decrease spontaneously when the given adjustors are not used. This principle seems to be necessitated by empirical observations. The memory of any particular thing or event wanes gradually with the passage of time, at first rapidly and then more slowly, following a curve similar to that for the reduction of temperature of a cooling body. Conductances above a certain value seem to behave like pressures, the rates of reduction of which are proportional to their own values at any moment. It would appear that this decay of conductance should be paralleled in consciousness by a corresponding unpleasantness, proportional at each moment to the negative rate of change.

A careful consideration of our actual assumptions will, however, show that they do not lead us to this conclusion, since decaying conductances will seldom be involved in the cortical synergy which is correlated with consciousness at the given moment. It is generally recognized by psychologists that consciousness is associated with that portion of the cortical process in which action tendencies are being built up or, at any rate, with the center of control in the cortex at any time. There must always be myriads of neurograms which are not concerned in the momentary control process, and these can have no direct representation in consciousness.

Such considerations seem to lead us into difficulties regarding the motivational completeness of an introspective record of affective experiences. If it is possible for conductances to decay, so to speak, "outside of consciousness," then a complete knowledge of the history of given action tendencies within experience would not suffice for an infallible prediction of the course of volition. Several lines of thought are suggested with reference to this situation. In the first place, it is possible that there is no actual decay of the conductances which are represented in particular neurograms, and that the difficulty of recall, or of the repetition of motor reactions, depends upon some change in the external connections of these neurograms. They may still be intact, but have become relatively inaccessible. This notion would appear to be supported by the possibility of restoring lost memories under hypnosis, and by the much superior accuracy of subconscious memory as compared with that of ordinary consciousness. However, even on this assumption, we have some apparently decadent conductance factors to consider, and it does not seem plausible that neurograms should remain absolutely intact over an indefinitely protracted period of time. It is much more reasonable to assume that the cortical tissue tends gradually, under the influence of a law of elasticity, acting against a viscous resistance, to return to its original condition.

If we admit such changes to be actual, we must acknowledge that there are certain factors which must be added to the affective history of the individual in order that we should be able to determine his volitional tendencies completely. It must be admitted that the majority of negative conductance changes which depend upon the principle of disuse do not find direct representation in consciousness. Nevertheless, it may still be possible to ascertain the values of these conductance changes—and the equivalent amounts of negative affection—from purely psychological data, if we suppose that such changes are completely determined as functions of the time and the initial conductance magnitudes. The law of decay during any period of disuse could be presumed to have a form similar to that of Newton's law of cooling.

The conductance of any given adjustor would then be expressed by a summation of terms, one group of which would depend upon affective processes within consciousness, and another group to be computed from the time intervals during which the adjustor in question has *not* been represented in consciousness. The terms of the latter group would all be negative. The conductance may either be decreasing or increasing while the adjustor has psychical representation, but will begin to decrease slowly as soon as it loses such representation. We may suppose that the terms of the second group, standing for the subtractive decay factors, are small compared with the terms of the first group, except when the intervals of disuse are very long.

It is clear that if conductances tend to decay in the manner above discussed, this tendency will be at a maximum when the conductances themselves are at a maximum. In other words, a habit or an impression which has been pushed to the extreme degree of perfection or efficiency will suffer in a greater proportion from disuse than will one which is much less highly developed. This expectation corresponds with the facts. To maintain oneself at a high degree of perfection in any art requires constant practice, whereas a low degree of perfection can be retained with very little effort. In the case of an adjustor which has been forced to its maximal conductance, the decay process is the only form of change which is open to it; neither exercise nor positive retroflex action can enhance its neurological efficiency any further. It would not be surprising if, in the case of such adjustors or neurograms, decay should sometimes occur even when the nervous mechanism in question is involved in the cortical processes of the moment, and hence has a representation in consciousness. In this case, of course, there should be a corresponding unpleasantness in the introspective field.

This consideration suffices, perhaps, to explain the phenomena which we describe by the words, "ennui," "being bored," or "suffering from monotony." The conditions which underlie ordinary "boredom" are probably somewhat complex, but they usually convert a form of stimulation, which at one time was a source of pleasure, into one of displeasure. If the conductance changes follow the course which is characteristic of most "asymptotic" functions, we should expect the decay to occur so as to be represented in consciousness only when the conductance has been subjected previously to an augmentative force stronger than that which is now operative. This might easily occur, for example, in the case of an individual who had led a life of adventure, containing many varied and intense experiences, and who is now compelled to remain in a monotonous environment. In this environment, he ruminates upon the past, and the memory records which are involved in this process of reflection are subjected to a much lower intensity of nervous excitement than they were at an earlier time. Consequently, they may continue to break down in conductance even when they occupy the controlling center of activity in the cortex. In other cases, we are "bored" by our perceived surroundings or by the words of some person who may be addressing us. Here there is apt to be some positive inhibition of a retroflex type at work. We dislike our circumstances, or the person who is speaking to us, or we are prevented by their presence from following out some strong action tendencies which we would otherwise pursue.

157. *Combinations with Other Principles*

Now, in order to understand the concrete psychophysical situations of everyday life, we must separate the various different kinds of components which enter into their determination. These components combine algebraically. Thus, the consequences of the law of exercise will be added positively to those of positive retroflex action, but negative retroflex effects will have to be subtracted from conductance changes which are attributed to exercise. In a similar manner, the principle of decay will be opposed by that of exercise or of the positive retroflex. Suppose that we consider a series of experiences which involve, in each repetition, a low intensity nociceptive component which has a practically invariable value. The early members of such a series may be predominantly pleasant, because the novelty effect is in excess of the negative retroflex influence. However, a point will finally be reached in the series of repetitions where, owing to affective adaptation or loss of novelty, the retroflex action will predominate over the exercise effect. At this point the experience will become unpleasant and the action tendency will fail to develop from this time forward. When superficially considered, such a series of experiences seems to exhibit a reversal of affective quality which might be attributed to the development of a monotony or boredom reaction.

As an example of this type of experience, we might consider that of walking between two different places. The muscular sensations of effort and fatigue which result are faintly nociceptive, but are overcome, for a while, by the novelty of the visual presentations. When this novelty has "worn off," the effort and fatigue sensations predominate and the experience becomes slightly unpleasant. A great many cases of "being tired" of a thing fall into this class. They are actually tiring in a sensory sense, even in our first experiences with them, but this effect is temporarily overcome by novelty. The principles of exercise and decay must be conceived as operating simultaneously even in connection with the first experience of any given kind, for as soon as the conductance has been raised above its congenital value, it will be subjected to a restoring force which increases in proportion to its departure from the initial magnitude.

If we are to judge from introspective evidence, the novelty principle can combine with that of the positive retroflex in a manner which is multiplicative as well as additive. Variety in good food has more powerful affective consequences than has variety in sense departments which are not characteristically pleasant. The same principle applies to erotic experience. A constant sexual mate or a fixed method of producing erotic excitation lose pleasure-producing power with repetition, but a new person or some variation in the method of stimulation may restore an original intensity of affective experience, reviving the "jaded appetite." The doctrine of "always to court and never to wed is the happiest life that ever was led" suggests this effect. The disappearance of the ecstasy of the first honeymoon, does not mean that a similar intensity of affection may not be experienced on another honeymoon with a different person. The affective fruitfulness of novelty in the erotic realm is so much greater than in other more neutral sense departments that, instead of adding the two influences thus: $n + r$, we must regard them as being combined thus: $n \times r$.

The mechanism of this multiplicative combination may be conceived somewhat as follows. We may suppose that the limit of conductance increase for a pure principle of exercise is much lower than that for positive retroflex action. However, even in the latter case there is a limit, but if the form pattern of sensory excitation which accompanies the retroflex process is varied, new sets of adjustor components are introduced which may be increased in conductance up to this superior limiting value. In this manner, variety provides the powerful retroflex agency with new material upon which it can act, and thus affords a great enhancement of affectivity in connection with the agency in question.

If it is true that the conductance limit for positive retroflex action is very greatly in excess of that for pure exercise, we should expect that the decay or disuse process, following advanced intensive retroflex action, would be quite rapid. In this case, it would always be possible for the retroflex agency to bring about an increase of the conductance of any adjustor even if the latter has once been pushed to its extreme limit, provided that a lapse of time is allowed during which it can suffer a conductance loss. In this way, it becomes possible for positive retroflex processes, in particular, to afford continued intermittent pleasure in consciousness in conjunction with an unvaried form of adjustment. Although this idea involves us in complications in the computation of volitional effects, it nevertheless seems to be consistent with our general principles and it provides us with the necessary basis for an explanation of the continued affective fruitfulness of simple forms of beneceptive stimulation, such as those afforded by good food or erotic excitation.

The considerations of the present chapter are not offered as a complete account of the pleasures of novelty and their associated processes, but merely as an exposition and illustration of general principles. We shall apply these principles in greater detail at a later point in our discussion, when we deal with concrete forms of complex motivation which particularly involve them.

Chapter XIX

The Nature and Basis of Emotional Experience

In accordance with the theory which we have developed in preceding chapters, we should expect affective experience to exist particularly in correlation with retroflex action. This should be the case, whether the action in question is primary or conditioned. Primary retroflex action provides the physiological basis for the characteristic pleasantnesses and unpleasantnesses of particular species of sensations, whenever they occur. Thus, pain is unpleasant because, psychophysically, it is accompanied by a direct process of conductance reduction in the cortex. Sweetness is pleasant because it is paralleled by a process of conductance increase which rests upon the beneceptive nature of the corresponding afferent nerve action. These conductance changes apply primarily to the associative linkage which connects the given motor reaction with a stimulus other than that which liberates the retroflex processes. As we have seen, this linkage may be that between proprioceptive and non-proprioceptive neurographic factors, or it may be a direct relationship between the latter and a focus of efferent innervation.

The stimulus, or afferent excitation, belonging to the inhibited or facilitated response, is represented in consciousness by certain perceptions and sensations which are ordinarily separate from those of the pleasure or displeasure that is directly affiliated with the retroflex. Although we regard the affection as being the direct psychophysical correlate of the rate of change of the conductance, certain psychological consequences should be observable as the affection progresses. These should take the form of a dissociation between certain kinaesthetic and certain non-kinaesthetic components of the experience. The kinaesthetic imagery and sensations will both tend to be modified. The affectivity will inhere in the consciousness as a whole, but will be attributed to the "pain" or "pleasure" sensations, because of the correlations of intensity which it exhibits with respect to the latter.

In the case of secondary retroflex action, the usual sensory "pains" or "pleasures" will be replaced by other sensations or perceptions, but otherwise the process will be essentially the same as that which has just been described. The psychological phenomena which accompany the operation of a secondary or conditioned retroflex closely resemble those which characterize the functioning of a so-called "complex." The psychical representation of the conditioning stimulus or nerve currents usually takes the form of a definite perception or idea, which brings a strong affectivity with it when it enters consciousness. If this affectivity is negative, there is inhibition of the concurrent volitional processes; but if it is positive, the latter are reinforced. The invading percept seems to be laden with feeling, and sets off a course of experience which usually has an *emotional* character. We do not, however, intend to imply that emotion may not arise also in conjunction with primary retroflex action.

158. *Extant Views Concerning Emotion*

The concept of emotion has always been of great interest to psychologists and philosophers, and has been subjected to a large number of different interpretations. The development of catalogues and analyses of various typical emotions was a favorite pastime among philosophers of the older schools; and religious thinkers almost invariably have looked to emotion to provide them with the foundations for their psychological speculations. In modern times, emotions have been reinterpreted in many different ways. An emotion has been regarded quite universally as a strictly psychological phenomenon, although behaviorists—like Watson—are, of course, compelled to treat it objectively.

McDougall's doctrine of the parallelism of instincts and emotions suggests strongly that instincts, or their operations, are the physiological counterparts of emotions, but he does not adhere consistently to this view, his tendency being to treat instincts also as mental factors. Watson separates instincts from emotions on the physiological plane. Emotions are ordinarily supposed to be characterized by a high degree of affectivity, but William James [169] and Lange [170] shocked the psychological world by denying this proposition and replacing affection by kinaesthesis.

In general, the terminologies of instinct and emotion are closely interwoven; so much so that McDougall evidently found it to be a rather difficult task to find appropriate names for the various members of his parallel lists under these two categories. Thus, he speaks of the "instinct of flight" and the accompanying "emotion of fear," although "fear" is frequently used as the name of the instinct in this case, "flight" being only one possible manifestation thereof. In the case of the very important "reproductive instinct" there seemed to be no available designation for the parallel emotion; which may be the reason why McDougall failed to regard this tendency as of primary significance in his original scheme. Now, since our own view as to the nature of instincts provides us with a ready method of designating them in terms of the retroflex mechanisms upon which they are founded, we can make free use of available instinct-emotion terminology to stand for the various developments from these primary tendencies.

It is characteristic of our view that what people ordinarily regard as "instinctive" action and emotional experience in everyday life is largely an elaboration of retroflex tendencies as a consequence of "experience." As an example of the manner in which these phenomena must be treated in harmony with the principles which we have laid down, we may consider the case of the so-called "instinct or emotion of fear." As discussed by McDougall,[171] fear involves movements of flight and concealment, and is congenitally arousable by a considerable number of specific afferent influences. The latter include: loud noises, being supported insecurely where falling is possible, the sight of animals, particular qualities of noise (such as that of a high wind), any unfamiliar object, and, particularly, a movement. Now, as opposed to this complex array of assumptions as to innate equipment, our view in the present book is that all human fears are derived by experience from the pain nociceptive mechanism, with its associated central and psychical functions. There is no inborn tendency to flee from particular types of objects or situations. The pain retroflex teaches us by experience to avoid any form of response which permits it to be excited. Pain has, of course, certain primitive reflex expressions of its own, but these are not sufficiently complex to correspond with McDougall's description, and they can only be passed over to the control of other forms of afferent excitation through conditioning.

McDougall cites numerous striking instances of apparently unlearned (instinctive) fear responses to specific stimuli which do not directly excite pain; but Watson,[172] Allport[173] and others refer to the even more striking failure of such reactions to occur in the majority of inexperienced individuals. The difficulty with McDougall's cases is that of demonstrating the supposed fact that no actual learning has preceded the response which he has observed. McDougall himself is obliged to call upon the conditioning, or associative, process to explain the full development of fear reactions in the mature individual, and it seems to be the best plan of thought to start with the simplest possible assumptions regarding the hereditary equipment, and to introduce definite specificities of response on this ground only when careful studies show that they cannot be avoided. We shall try to explain these specificities on the basis of simple assumptions in combination with "experience."

159. *The Conditions for Emotional Experience*

We may first face the question as to whether we should use the word "fear" so that it includes the phenomena which are associated with strictly *primary* retroflex processes, based upon pain stimulation. It seems entirely consistent with common usage of the term to say that we *fear pain;* in fact, according to our present view, pain is the only thing which we fear, ultimately. When an infant is subjected to painful stimuli for the first time, he manifests an emotion which seems properly to be described as fear, and his behavior is such as finally to relieve him from the nociceptive stimulus, unless the situation is excessively difficult. Thus, he shows an "escape reaction." However, it seems best to restrict the use of the term, fear, to the operations of retroflexes which are set off by a *conditioning* stimulus. This will be more in harmony with such conceptions of the instinct or emotion as McDougall's, or with popular ideas. We shall not endeavor to limit the term to a purely psychical meaning, but may permit it to cover both the physiological and the conscious processes, including the habit formations which underlie them. The first time that a child is subjected to painful stimuli, he undoubtedly has an emotional experience. His consciousness is strongly suffused with unpleasantness, and there is a powerful outbreak of kinaesthetic components; the world of perception and imagery becomes kaleidoscopic and rotates around the pain sensation in a confused manner. This continues until the pain has disappeared, after which a more quiescent condition supervenes.

Now, the definitions of *emotion* which have been offered by psychologists and philosophers are so numerous that it would be a waste of time to endeavor to summarize them all. However, taken collectively, they indicate the following constituents as being of importance in the make-up of an emotional experience. In the first place, there is strong affectivity. Secondly, the component of bodily feeling, especially kinaesthesis, depending upon the excitation of visceral or proprioceptive sense-organs, loom very large. Thirdly, the behavior and volitional tendencies are relatively unformed or non-habitual. Fourthly, there is a considerable accompaniment of reflex action. Fifthly, emotions tend to ally themselves with "instincts." Various writers have emphasized one or another of these factors, and sometimes have claimed that emotionality is dependent upon one of them alone.

It is impossible to lay down a scientific definition of emotion which will correspond exactly to the popular use of the term. This might still be true even if such usage were entirely consistent, since scientifically established lines of cleavage between concepts cannot be expected to follow those adopted by common sense in every case. Only an approximate correspondence can be expected, so that we should not be surprised if a scientific definition of emotion rules out certain cases which are commonly included under this designation. However, the majority of the technical definitions, which have been offered, suffer from an attempt to attain undue simplicity. It is our view that an adequate formula for emotion must be quite complex in itself, if the formula in question is couched in strictly psychological terms. We shall agree that the concept of an emotion is to be limited to a subjective application, and is not to be extended to physiological mechanisms or activities. But it may be possible to define emotion in terms of its physiological conditions, and thus to gain simplicity of statement.

Following this idea, we may suggest that *an emotion is constituted by the series of psychical events which ensue upon the excitation of a retroflex, under the condition that successful responses to such excitation are not fully prepared in advance.* In other words, the emotional experience accompanies the characteristic formative operations of the retroflex mechanisms, but more particularly the early stages of this process, in which the affectivity is concerned with the selection of the most successful trial in a series of more or less random actions. Another way of stating this proposition might seem to be to say that emotions accompany what we have called appetitions, the latter having been defined in a physiological manner. However, the concept of emotion is intended to be somewhat broader than such a definition would imply, since appetitions appear to be determined solely by nociceptive stimulation, whereas emotions may also be associated with excitations of the beneceptive type.

160. *Description of the Typical Emotional Experience*

It will be noted that, in accordance with the above definition of emotion, the latter comprises a series of consciousnesses, or an *experience* in our technical sense of this term. This is a somewhat novel interpretation, since the majority of psychologists have attempted to define emotion in such a way as to make their definition applicable to single moments of consciousness. Thus, according to James' view, a momentary psychical cross-section might be emotional if it contained the right kind of kinaesthesis. The doctrine of the present book demands, however, a rather definite sequence of events, forming a characteristic pattern in time; no restricted phase of this process can be regarded properly as constituting an emotion. Hence, it would be a contradiction of terms to speak of "an emotional consciousness," unless this phrase were used simply to designate some important phase of an emotional *experience*.

The characteristic course of such an experience can be described somewhat as follows. The initial event is the appearance of a sensation or perception which represents the stimulus to positive or negative retroflex action. This stimulus, of course, may be either primary or conditioning. In the former case, it will be represented in consciousness by a relatively unorganized sensation, whereas in the latter case it is likely to be a complex perception. If we consider the emotion to be that of fear, we may offer the example either of a direct pain sensation, or the visual presentation of a wild animal, such as a bear. The entrance of this initial sensation or perception into consciousness is accompanied by a strong unpleasantness. The next phase of the experience will vary with the degree of advancement of the individual. In an infant, experiencing pain for the first time, the kinaesthetic presentations which existed in consciousness at the moment of entrance of the pain will be repressed and replaced by other kinaesthetic images, which will enter the focus of attention and be filled in by corresponding kinaesthetic sensations, ensuing from the corresponding actual movements. In the case of an adult who has a knowledge of the appearance and dangerous character of a bear, the second phase of the experience will consist in the appearance in consciousness of an image representing the *absence* of the wild animal. This image may be a visual depiction of an environment *without* a bear.

This second phase in the emotional experience may be designated as the *image of the desideratum*. Its existence is to be attributed entirely to associations depending upon previous experience, which usually will have been of a non-emotional character. Two cases may evidently need consideration, one in which the individual has had a previous encounter with a bear in which he has learned by actual experience that the animal in question can inflict pain. The other alternative, and the commoner one, is that the man has never met an unshackled bear before, but has been instructed through reading or conversation concerning the nature and ferocity of the beast. He may have seen bears in cages, or chained to posts, or may merely have looked at pictures of them, or have become acquainted with them wholly by description. At any rate, an associational system has been created in advance which links the bear image with that of *escape,* which means getting into an environment lacking in animals of this sort. The same associational experience has attached the bear, considered as a pattern of visual excitation, to the pain retroflex mechanism.

The next phase of the emotional experience involves the appearance of images representing various possible means of escape, or of *realizing* the first associationally aroused image in actual perception. These *instrumental* images may be visual, auditory, tactual, or of any conceivable type, but they are most apt to be kinaesthetic in character. In this latter form, they directly represent various alternative lines of action which may enable the person to escape from the undesirable environment or condition. The instrumental images are at first in the margin of consciousness, being unclear, or not attended to. Consciousness is dominated in the beginning by the primary perception of the bear and, later, by the image of the desideratum. However, when one of the instrumental images, in kinaesthetic form, enters the focus of attention, a corresponding motor innervation ensues, and this is naturally followed by a filling in, or realization of the kinaesthetic image by vivid sensation. We may suppose that the victim turns in a certain direction and runs. If this procedure is successful in removing the perception of the bear permanently from the margin, as well as from the focus, of consciousness, the emotion will pass into its terminal phases. If, however, the first instrumental image proves to be unsuccessful, it will be repressed, along with the corresponding form of behavior, and a different instrumental image will supervene and be attended to, the motor reaction changing correspondingly. Thus, if the individual fails to escape from the animal by running, he may choose to climb a tree. If the bear catches him, he will struggle, strike at the beast, etc., modifying the kinaesthetic and motor instruments until success is achieved, or he is physically overcome.

In the case of a child who is struggling with a purely sensory source of discomfort, the primitive emotion will follow the same general course, one kinaesthetic tendency supervening upon another until the pain sensation disappears. We assume that if such an inexperienced child, or other person, should meet a bear without ever having received any instructions concerning the nature and qualities of this animal, there would be no emotion until the animal actually attacked. The perception of the bear would not be accompanied by unpleasantness. On the contrary, it might very well be expected to arouse pleasure, as a consequence of its novelty, and to lead to behavior of a type tending to make the situation more dangerous rather than less so. Attack by the bear would, of course, cause direct pain, in which case the emotional experience would be similar to that accompanying the first siege with an open safety pin. However, the pain would become associated with the bear perception, and other features of the particular experience, so that at a later time, if the child were rescued, he would be prepared with a fear reaction of the more complex type which we have described in the preceding paragraph.

161. *The Affective Course of Emotional Experience*

Now, let us suppose that the man is successful in escaping from the bear, so that he perceives himself to be in an environment lacking the bear, or maintaining the latter at a safe distance. This actual perception is a realization or fulfillment of what we have called the image of the desideratum; it is a *satisfaction of the desire* which was set up in consciousness as a consequence of the initial phase of the experience. This process of satisfaction may be regarded as terminating the emotion proper, but it is, of course, followed by phases having the nature of after-effects. The entire experience is apt to be reviewed in memory, and there will be accompanying sensations of fatigue, relief (resulting from the removal of the motor tension), etc.

In order to make this account of emotional experience complete, we must describe the course of the affective intensity throughout the emotion. The affection exhibits characteristic phases of change which may be regarded as symptomatic of the emotional sequence of events. As already indicated, in the case of an unpleasant emotion like fear, the initial perception depresses the affective intensity below zero to a strongly negative value. The appearance of the desideratum image is accompanied by a considerable alleviation of this negative affection, which is usually carried still further by the arousal of the instrumental images. When one of the latter enters the volitional focus, and is reinforced by sensations ensuing from actual movement, there is another lightening of the negative affection. From this time on, the affective intensity will vary with the actual course of the emotion, increasing in negativity if the initial perception remains in consciousness, in proportion as it waxes rather than wanes; and decreasing as it wanes. If the struggle is successful and the desideratum image is fulfilled, this final phase is characterized by the passage of the affectivity through zero so that it swings strongly positive. The after-images, or memories, will be pleasant or unpleasant, according to the phase of the experience which they represent. This course of the affection is diagrammed in Fig. 5.

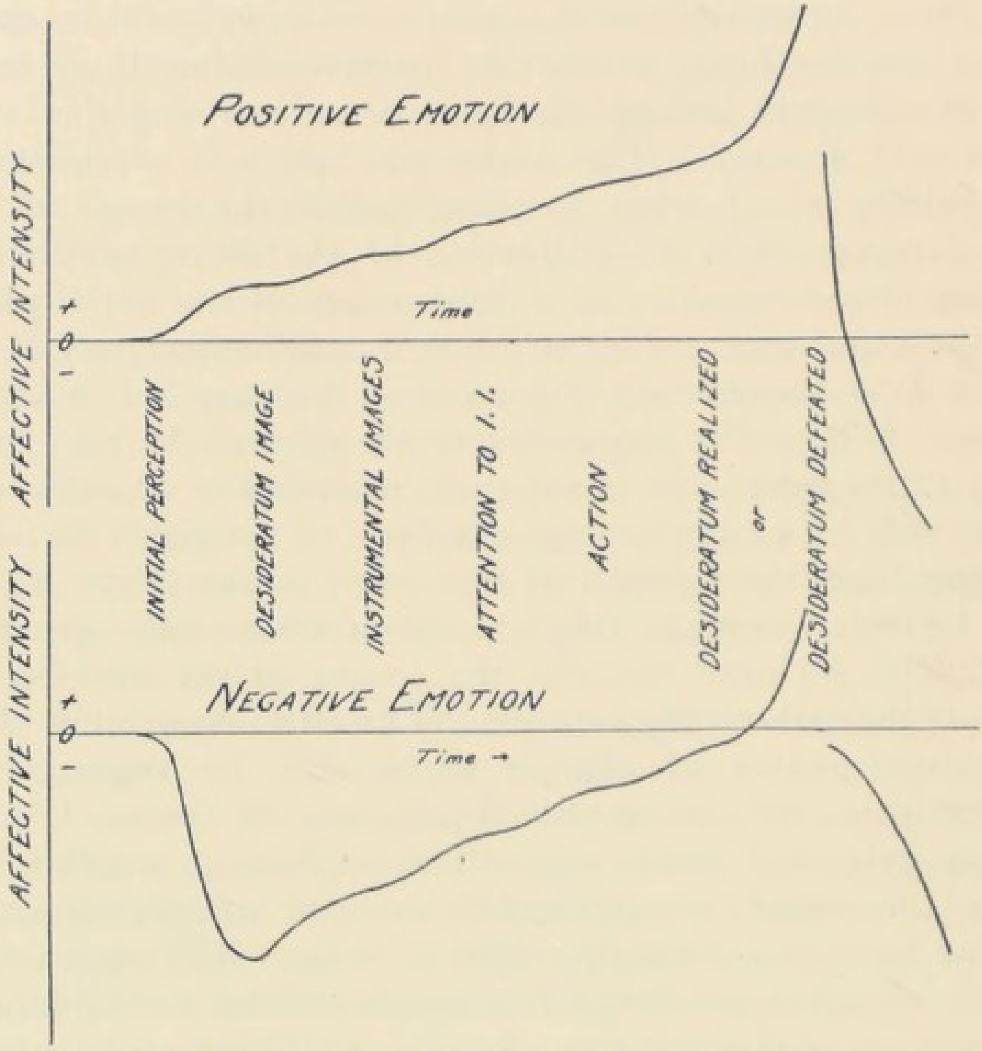

FIG. 5. THE TYPICAL AFFECTIVE COURSE OF EMOTIONS.

This diagram represents the successive phases of an emotional experience, as described in the text. The general manner of variation of the affective intensity throughout the temporal course of the experience is shown for both positive and negative emotions, and for the alternatives of satisfaction or defeat.

The emotional experience will also be accompanied by special sensations, attributable to the reflexly induced changes in the condition of the organism, which occur directly or indirectly because of the arousal of the pain centers. The most important of the direct effects will consist in the excitation of the sympathetic section of the autonomic system, with consequent secretion of adrenin and the reinforcement of physiological defence systems. Indirect effects will include accelerated heart action and breathing, which follow from the violent muscular exertions, and a complex array of chemical alterations as a result of the heightened metabolism. The increased general tonus of the entire voluntary musculature will give rise to sensations of tension and effort, apart from the specific sensations of movement which accompany particular phases of action.

Emotions may be classed as positive or negative, according as the initial perception or idea brings pleasantness or unpleasantness, respectively. Fear is obviously an example of a negative emotion. The emotion of sexual love, which we shall consider below, is of the positive type. As a rule, the entire course of a negative motion is unpleasant; with the exception of the terminal phase, provided that the responses which accompany the emotion are finally successful. Similarly, the total experience in positive emotion is pleasant, being particularly so in the terminal phases, if the latter accompany success. On the other hand, if the positive emotion terminates in failure, its concluding stage will be strongly unpleasant, producing the type of affective consciousness or experience which is known as disappointment. It is obvious that either positive or negative emotions can be accompanied by either failure or success, and that the character of the emotional experience must depend upon this condition. The question of success or failure affects the terminal phase of the emotion to the greatest extent, but may be applicable in some degree throughout the progress of the emotional struggle.

162. *The Course of a Positive Emotion*

The course of a positive erotic emotion may be described somewhat as follows. The initial phase is the appearance in consciousness of erotic sensation or lust at a low intensity, or of some perception which has become associated with this sensibility. We have suggested that very low intensities of erotic excitation are nociceptive and hence should be accompanied by unpleasantness in consciousness; although at all higher intensities there can be no question as to their pleasantness. The exact course of the action tendencies must, therefore, depend upon the intensity range within which the initial sensation or perception falls. If the intensity is low, we may expect current kinaesthetic factors to be repressed, and new ones to take their places, this process continuing either until the excitation subsides, or until it increases in intensity so as to become pleasant. In the latter event, the particular form of action which brings about the change to pleasure will tend to persist and, in the normal course of events, to cause a steady increase in the intensity of erotic excitement, culminating in the orgasm. The commonest outcome of such an experience in a child is the establishment of some form of autoerotism. It is to be noted that a positive emotion, based upon the primary excitation of a positive retroflex tendency, differs from a negative emotion in that there is no continued replacement of one action tendency—or kinaesthetic constituent of consciousness—by another, in connection with the search for a "successful" form of response. The reaction which initially arouses a positive retroflex is *ipso facto* successful, and needs only to be "stamped in."

In the case of an experienced adult, erotic emotion is much more complex. The exciting stimulus is apt to be of an intricate pattern type, leading to definite perceptions, in consciousness. If we consider the male of the species, the perception in question may well be that of an attractive female. Just what kind of a female will prove to be "attractive" will depend upon the man's previous educational experience. We may consider the case of a young man who has had no intimate experiences with the opposite sex. However, he cannot have avoided having become aware of the nature and significance of erotic feeling. Even if he has never developed autoerotic habits, he will have experienced sexual sensations in dreams. Moreover, he has been rather thoroughly instructed by his acquaintances, by books, dramas, and possibly even by his parents, that the female is the natural object of erotic feeling. The principles which are involved in this case are exactly the same as those which apply to the case of the bear. Having once been instructed as to the dangerous nature of this animal, we are automatically frightened when we see one at large. Similarly, having been convinced through instruction that the female is the only satisfactory gratifier of the erotic sensibility, the sight of her becomes capable of arousing the positive retroflex of sex and the accompanying feelings. There are very few males of the human species, past the age of puberty, who do not have a reasonably clear conception of the process of such gratification.

It is to be assumed that the appearance of the initial perception in the emotion of love, will be followed by a desideratum image, as in the case of the emotion of fear. In the former case, it will represent some form of sexual intimacy with the female. The exact nature of this representation will depend upon the associative history of the given male. In the case of the ideally inexperienced young man, the desideratum is apt to be simply that of embracing or kissing the girl, because the more biological sexual relationships have been discountenanced by his mentors, and have not been so freely represented to him in stories, plays or motion-pictures as embraces and kisses have been. The third phase of the emotional experience will naturally involve the appearance of *instrumental* images, standing for means by which the desired relationship with the object of love may be achieved. These are likely in the first instance to be kinaesthetic images, representing the acts which can realize the contemplated relationship. However, these images may be inhibited, or maintained in the margin of consciousness, in consequence of the simultaneous appearance of ideas which oppose them and stand for the possibility of a rebuff; these being based also upon associative connections established by previous observation or instruction. In this dilemma, verbal images may be aroused, suggesting some method of seduction by persuasion. One or another of these instrumental images will be adopted and receive expression in action. If it is successful, the image of the desideratum will be satisfied, or filled in by sensory material so as to constitute a vivid perception. If the first instrumental image which is adopted is a failure, other such images will appear and be tried.

Since the course of love—true or untrue—seldom runs smoothly, other factors than the erotic are likely to enter into the course of the emotion. If the suitor is rebuffed, this process will presumably involve the associative or even the direct arousal of pain tendencies. These will naturally render the experience temporarily unpleasant, and will bring about an inhibition of the reaction to the erotic excitation. If there is no conflict of this sort and the lover finds the object of his desire in his arms, he will normally experience voluptuous sensations which may be attributed to the secondary arousal of the erotic center. The pleasure will be enhanced still further through the action of the principle of novelty, which will combine, as we have seen, in a particularly fruitful manner with positive retroflex factors. The emotion may continue as a highly pleasant form of experience, depending upon the mere maintenance or repetition of a single act of intimacy. The intensity of the affection rests, however, upon the fact that a habit, or a specific form of response, is being stamped in. When this has been thoroughly established, the emotional intensity will wane, and some new type of response will be required to yield the same "kick." Since respectable sexual relations develop slowly, we may suppose the love emotion to recur at intervals, as a manifestation of increasing intimacy, leading finally to processes which set off the consummatory reflexes, with consequent lapse of the emotionality.

We shall discuss the finer details of erotic motivation at a later point, but a word may be said here concerning the process of "falling in love," as an illustration of general principles. It is a familiar idea that this process consists in the conditioning of the sexual instinct by the visual or auditory representation of a particular person. Our formulation of this view must obviously be that the visual pattern or group of patterns which result from the presence of the loved person, become capable of arousing the positive erotic retroflex. This must be attributed either to the sensory excitation of the erotic center in connection with the presence of these visual stimuli, or to a secondary excitation in the same connection. The commonest cause of "falling in love" appears to lie in some degree of physical intimacy. The idea of such intimacy (e.g., embracing or kissing) has been established by previous experience as a general basis for the conditioned arousal of erotic feeling, regardless of the special identity of the object of this intimacy, so long as the object falls within a certain class. The erotic excitation is then transferred from this more general conditioner to the specific stimuli or perceptions which embody it in the given instance. One experience of this sort is usually sufficient to render the individual erotically sensitive to the perception of a particular person of the opposite sex—or possibly the same sex,—so that the sight or the voice of this person become immediate sources of pleasure and emotion. However, the emotional aspect of the experience will disappear with time. The waning of love as an emotional affair is paralleled by its waxing as a habit.

The affective course of a positive emotion, such as that of love, has a general resemblance to that of a negative emotion, in spite of the contrast of pleasant and unpleasant which exists between them. This resemblance consists in the kind of *changes* of affective intensity which tend to occur as the emotion progresses. In the case of the positive emotion, the initial perception is mildly pleasant, and the pleasantness tends to *increase,* as the experience proceeds, reaching a high maximum value at the end. In the case of a negative emotion, the initial perception is strongly unpleasant, and successive phases of the experience characteristically involve a *decrease* in the negative intensity, which passes finally through zero, to be replaced by a positive value in the terminal phase of the experience. Consequently, we may say that, subsequent to the initial and disturbing perception, the dynamic courses of both kinds of emotion are similar, in that there is an *increase* of affective intensity throughout both of them. (It will be recalled that the decrease of a negative quantity is equivalent to the increase of a positive quantity.) Of course, this pattern of affective change is only an average characteristic, being upset in particular emotional experiences by interferences, failures, the introduction of foreign affective forces, etc. However, we may regard this temporal pattern of affective change as being characteristic of *a desire and its satisfaction.*

163. *Despair and Disappointment*

We must obviously consider the case of emotions which fail to find such satisfaction. In this case, the terminal phase of the experience is unpleasant for both positive and negative emotions. If the wanderer in the woods does not escape from the bear, but finds himself in the clutches of the wild animal, the unpleasantness of his experience will become extreme even before he has been subjected to actual physical pain. This may be attributed, in part, to the powerful associative arousal of the retroflex, and, in part, to the inhibition of the desideratum image which represents escape from the bear. The mental state which results from the non-satisfaction of a negative emotion is that of *despair.* In the case of a positive emotion, such as love, the failure of the image of the desideratum to be realized involves a corresponding inhibition and a strong negative affection, which is usually known as *disappointment.* Here, we must look for some agency which can account for the inhibitory effect. The nature of this agency will be apparent in particular cases. If a lover should be slapped in the face, it is direct pain. If the rebuff is merely verbal, the pain retroflexes are set off in a more indirect fashion. If the loved person is physically removed from the scene, the inhibitions have a more complex basis, which we shall consider in our analysis of the mechanism of *sorrow.*

164. *The Variety of Emotional Possibilities*

We have considered the emotions of fear and love in the present chapter merely as illustrations of general principles. It is obvious that they may assume diverse forms in different individuals under various circumstances. Our general principles are sufficiently flexible to permit of the emotion of fear being felt with respect to any perception or sensation whatsoever, if circumstances have the correct form. Thus, we may become afraid of automobiles, airplanes, fog, dirt, the color red, or anything else. If the fears are not biologically or socially justifiable, they are regarded as abnormal and classed as "phobias," but their mechanism remains the same as that of more useful aversions. In the case of love, the object may be a person of the same sex, an article of clothing, an animal, a corpse, or some entirely irrelevant thing. We regard such erotic likings as perversions or fetichisms, but there is no special principle involved in their explanation; they are all accounted for by the same principles which underlie so-called normal tendencies. These identical principles will prove to be applicable to all retroflex systems and their accompanying affections. We have listed a considerable number of such systems, and others will probably be discovered. The operation of any one or any combination of them may be responsible for emotional experiences of a characteristic kind. Thus, instead of expounding the details of the emotion of fear as a corollary of the pain process, we might have considered the emotion of disgust as a consequence of unpleasant taste or smell sensations. On the positive side, we might have treated of emotions based upon the sight of good food. The vocabulary of emotionality does not provide us with a sufficient number of terms to name all of the possible types of emotional experience, which can be generated and explained according to these principles.

Chapter XX

Desire and Purpose

The concept of purpose is one which appears to be of fundamental importance for the theory of motivation. This concept has, however, been the object of radical disagreement among psychologists. Some of the latter, such as McDougall,[174] have regarded it as furnishing the clue to all psychological thinking, whereas others, like Titchener,[175] have rejected it entirely as a basic explanatory principle. Münsterberg[176] wrote two psychologies in the same book, one in terms of purpose, and the other wholly without it. Mechanists have naturally objected to accounts in terms of purpose, whereas more sentimental thinkers have found this notion the easiest one to use in their attempts to solve the problems of human motivation. For a long time, philosophers have contrasted explanations of the purposive type with those in terms of mechanical causation; they have implied that the distinction between so-called *final* and *efficient* causes is fundamental, and that the two notions are incapable of being reduced to a common denominator.

165. *The Distinction Between Purpose and Function*

It is our view that this conflict between the purposive and the mechanistic theories is attributable to a confusion of ideas and to superficiality of analysis. Purpose, as it is understood by the man-in-the-street, is undeniably a factor in life, and no amount of introspection or physiological research can rule it out. A psychology which eliminates purpose cannot possibly correspond with the facts. However, the man-in-the-street cannot tell you what purpose actually is, although it is quite likely that he will give an account of it which closely resembles that which is offered by the purposive psychologist or philosopher. The commonest confusion is of course that between purpose and *function*. Probably no enlightened modern thinker intends to identify these two ideas, but their complete separation appears to present emotional difficulties. The mere fact that a structure is subservient or instrumental to the maintenance of life seems to endow it with purpose. Even the appropriateness of the properties of matter to this end has been suspected of purposiveness by L. J. Henderson,[177] and this in spite of the fact that the outstanding contribution of Darwin's thought to science lay in the demonstration of a way in which adaptation can be explained without reference to purpose.

The exact import of Darwin's teachings has probably been missed even by many of his most devout adherents. Possibly he did not perceive it in its broadest aspects, himself, since he was concerned to show that the purposive account of organic structure and function could be superseded, instead of dealing directly with the facts of evolution, without any reference to purpose. The essence of Darwin's formula lies in a proposition which seems almost tautological. It says that only those structures can continue to exist which are so constituted as to make them capable of existing. So long as the universe exists it will contain structures, and some of these will endure, substantially unchanged, longer than will others. No structure endures forever, but its life will be long in proportion as its constitution is such as to contribute to stability. If old structures are destroyed, the conservation of matter and energy demand that new ones should be generated. Nothing could be more in harmony with rational expectation than that the structures which continue to exist—like those of organic species—throughout long periods of time, should be so constituted as to be capable of maintaining such existence. Otherwise, as Darwin correctly indicated, they could not be here. If we regard the process of evolution, thus, from a strictly objective standpoint there is certainly nothing in it anywhere to suggest the notion of purpose.

If, on the other hand, we make a careful study of purpose, we find that it is by no means independent of the Darwinian principles. Although purposes do not explain evolution, evolution can certainly explain purposes.

166. *The Psychological Nature of Purpose and Desire*

We may agree with McDougall that purpose is a mental category. If we were restricted to the purely physiological standpoint of the earlier portion of our discussion in this book, we should have no real occasion to introduce the notion of purpose. It is true, of course, that there must be physiological counterparts, or parallels, of purposes which bear the same relation to behavior as do purposes in everyday thinking. Nevertheless, no useful result could be achieved by calling such physiological mechanisms purposes. But if we consider the psychological account of the typical emotional experience which we have given in the preceding chapter, we find that it has an aspect which corresponds closely with the ordinary idea of purpose. From the introspective standpoint, a purpose may be identified with what we have called "the image of the desideratum" in the emotional experience. It is a representation within consciousness, in imaginal form, of something which is *desired*. The "thing" which is thus desired is the *satisfaction* of the image, or its filling out by sensation so that it becomes a vivid and realistic perception. Thus, the man who is faced by the bear entertains the purpose of escape, as an image which faintly represents the terminal phase of the emotional experience—if the latter is to be successful.

It is evident that this definition of purpose rests upon a definition of desire. We have already suggested in the preceding chapter the meaning which we shall assign to the latter term. The course of a desire is characterized by an increase of affective intensity; whether this increase occurs in the region of positive or of negative values of this variable—consisting, of course, in the latter case, of a decrease of negative intensity. In other words, the course of a desiderative experience involves a positive value of $\frac{da}{dt}$ (the rate of change of the affective intensity). However, it is probably necessary to go further than this and to say that the desiderative experience manifests the operation of a force which tends to produce such a change in the affectivity, even when the change in question is not actually realized. This means that the succession of images, acts of attention, etc., within the experience, are selected or rejected in accordance with their ability to minister to the affective increase in question. The embodiment of this force or tendency is to be looked for on the physiological side in the action of some retroflex mechanism. If the retroflex is of the negative kind, it will operate so as to inhibit all responses which do not succeed in removing it, and, consequently, will work toward the reduction of the unpleasantness of the corresponding experience. On the other hand, if the retroflex is of the positive variety, it will act in such a manner as to facilitate any form of response which continues its excitation, thus tending to maintain or to increase the positive affection in consciousness.

The desiderative or purposive consciousness may have many different forms and courses of change. The most primitive kind of desire presents no definite images of the "end." It constitutes the "blind purposeless striving," concerning which philosophers like Schopenhauer have waxed so eloquent; but it will recognize its "end" when it finds it. Such desire—prior to any experience which can establish associations informative as to the means by which the desire can be satisfied—will involve a process of volitional unrest; various kinaesthetic images will appear, be attended to, and be retained or rejected in accordance with affective consequences. All absolutely uneducated desires must be conceived as unpleasant. However, nearly all of the desires of human beings who have passed beyond the stage of early infancy are based upon previous, more or less accidental, affective experiences, or upon verbal information in association with such experiences.

Thus, positive desires are directed towards the acquisition of particular pleasant forms of experience which have occurred at least once before; whereas negative desires are directed towards the escape from unpleasant experiences, by means which have been demonstrated at an earlier time. A child will desire to avoid punishment, through some device which may have succeeded previously; or the child may desire candy because he has tasted it before and liked it. He may also desire particular playthings which he has never possessed, but has seen in the hands of other children, or has heard about as sources of amusement. In such cases, some initial perception arouses the desideratum —as in the case of the emotional experience—through an associative linkage. This association is based not merely upon the general principle of impression, but also upon that of retroflex selection, operative in the past.

The above account of desire is evidently hedonistic in character, since it portrays desire as an urge towards greater pleasantness. However, it is not necessary for us to imply, at least at the present stage in our argument, that there is any such thing as desire for pleasure, or relief from displeasure, in the abstract. Actual desires seem to relate to particular forms of pleasure or displeasure. Certain thinkers, notably McDougall [178] and Perry,[179] have claimed that desire or "interest" are independent of affective consequences and are directed solely towards concrete objects. The child desires candy, and not the pleasure which the confection will yield. We may agree, tentatively, with this proposition, although maintaining at the same time that the existence of such specific desires is dependent historically upon the affective aspects of similar prior experiences. The child would have no "interest" in the candy if it had not given him pleasure in the past. Both McDougall and Perry seem to admit that it is characteristic of the satisfaction of desires to yield pleasantness, or to involve a relief from unpleasantness.

This does not, however, preclude the possibility that desire may sometimes be generalized so that it applies explicitly to the affective aspects of all experience. A person with good powers of introspective observation, and a capacity for scientific thought, may be expected to notice that all specific desires are signalized by an affective trend in the direction of increased happiness. Using this observation as an experiential basis, such a mind might well begin to desire pleasure or release from relative displeasure regardless of content. But all such considerations fail to penetrate to the roots of the matter, since the thing which counts from the motivational standpoint is not the explicit content of the desiderative experience, but the laws which govern it. It is our thesis that these laws have a hedonistic form.

Now, purpose differs from primitive desire mainly by being more explicit and advanced. It is an educated form of desire; or desire is purposive insofar as it represents in advance the form of consciousness or experience which will bring satisfaction. Purposes may evidently vary in their persistence, complexity and the range of their applications. However, they are always characterized by some form of mental representation which is accompanied by a selective treatment of other mental representations, the latter appearing as a consequence of association with the purposive image and standing for possible means of its realization. Moreover, the trend of such purposive selection is away from the unpleasant and towards the pleasant. The satisfaction of a purpose is pleasant and its dissatisfaction is unpleasant. The pleasantness of satisfaction is to be attributed, not alone to retroflex processes, but to strong increases in conductance due to impressional principles. The purposive, or desideratum image, corresponds to a system of nervous connections which is prearranged and predisposed to rapid conductance increase. When the appropriate pattern of afferent excitations appears, it will particularly augment the conductances of such a predisposed neural arrangement.

167. *The Causal Efficacy of Purposes*

It will be perceived that the scheme of the nature of purposes, which we have outlined, conform in certain ways to the usual teleological account. Purpose represents, and, in a sense, possesses, an "end." This "end" is the terminal phase of the emotional or action experience, assuming it to be "successful." This terminal phase is vaguely represented by the "desideratum image." However, it is evidently a mere confusion of meanings to say that the "end" is present in the beginning, or controls the process. What is present is merely an imperfect symbolization of the "end," and since the latter is non-existent it can have no bearing upon the situation. Nevertheless, we might state correctly that the desideratum image has been determined by the "end" or terminal phase of a *previous* experience of the same general sort, or by some more complex but equivalent biographical factor. While there seems to be no scientific sense in the notion that the "end" determines the process, it is easy to see how such confusion of thought can arise with reference to such a psychological process as that which we have considered: since the purpose is itself a "thought," taking the "end" as its meaning. It is therefore subject to the usual "stimulus error," which substitutes meaning for actual mental content. So far as the operations of purpose can be observed introspectively, they follow the normal formula of efficient causation. The desideratum image appears to regulate the associative and volitional processes as if it were a present determining agency. There seems to be no reason for denying the reality of this effectiveness, so long as we confine ourselves strictly to the psychological domain, and also no excuse for distorting it into the fantastic scheme of "final causation."

The apparent causal efficacy of purpose in the mental domain is attributable to its correlation with conditioners of retroflex action. We have seen that retroflexes act as *controlling agents,* inhibiting or facilitating forms of response in accordance with their bearing upon the continuation of the given retroflex processes. Purposes appear to act in much the same manner on the mental side of the psychophysical system, enhancing or repressing ideas and volitional tendencies in accordance with their abilities to subserve the purposes in question. The exact relationship between purpose and retroflexes depends, however, upon whether the latter are negative or positive. Primitive inexperienced desire, involving the direct arousal of a retroflex process, is associated with negative retroflexes only. On the psychological side, in this case, there is no representation of the object of the desire. Purpose and typical desire are only possible when retroflexes have been *conditioned*, and associations have been established through experience.

In the case of a positive retroflex, the purpose or desideratum image may be regarded as the psychical parallel of the conditioning sensory pattern. Thus, the sight of food arouses a desire to eat it. Both the appearance of the food and the representation of the act of eating have been associated with pleasant gustatory and olfactory sensations, which correspond to the direct excitants of the positive retroflexes. The purpose in this instance may conceivably consist in representation of the "taste" of the food, or it may be composed of kinaesthetic imagery, standing for the acts of ingestion. In sexual desire, the purpose may represent the sensations of the orgasm, or some associated perceptions, such as those of contact with a person of the opposite sex. In these examples, the relationship with the retroflex or pleasurable sensations is so direct that there is no difficulty in recognizing the principles which are involved. If, however, we consider a case such as that which is presented by a man who is walking down the street with the idea in mind of purchasing a new suit of clothes, the connection with retroflexes is somewhat more obscure. However, it is our belief that the image representing such a purchase is actually correlated with neurograms which have been facilitated in a retroflex manner. New clothes aid a man's standing in the community and assist him in earning his bread and butter, as well as protecting him from cold. In the case of a woman, they have a very direct relationship to success in the sexual sphere.

The direct conditioner of a negative retroflex cannot be represented by a positive purpose in consciousness, since such a conditioner sets up processes which tend to eliminate it from the situation. In the case of a negative retroflex, the purpose corresponds to the pattern of the elimination. If we wish, we can say that the conditioner of a negative retroflex corresponds with a *negative purpose,* or a mental representation which tends to be repressed, the related positive purpose embodying its contrary. In general, the purpose in such cases will correspond to the *least inhibited* of all of the forms of response which have previously been concurrent with the operation of the negative retroflex in question. If the individual was successful in eliminating the unpleasant sensations, the least inhibited response will naturally be the one which accompanied such elimination. It is highly probable that this response will not only fail to be strongly inhibited, but will actually be facilitated. This latter effect may be attributed to several conceivable processes: firstly, rebound effects accompanying the release of the inhibition (analogous to what Sherrington calls successive spinal induction); or, secondly, the possibility which we have already suggested, that a decrease of nociception acts beneceptively. A third possibility enters when the given type of escape has been effected or imaged more than once, and lies in the reinforcement of the desideratum pattern by the nerve currents corresponding to actual perception. At any rate, we observe that the final stage in a successful negative emotion is positively pleasant.

Advanced human purposes are ordinarily founded simultaneously upon a number of retroflex conditioners, or their negations. Thus, the very prevalent purpose among men of making money, represents a condition for the arousal of all positive retroflexes and also for the avoidance of all negative ones. It is obvious, on the psychological side, that purposes can be arranged into a hierarchy in which one purpose is subservient to another. The purpose to earn money is subservient to that of obtaining food, of obtaining clothing, of securing a sexual mate, and innumerable other purposes which may be entertained separately. Many of the latter, however, can also be regarded as subsidiary. Thus, obtaining food is instrumental to avoiding hunger and gaining the pleasures of eating. Winning a mate is instrumental to erotic gratification. Our thesis must evidently be that the majority of purposes, no matter how advanced, are ultimately subservient to the avoidance of the basic unpleasant sensations and the acquisition of the pleasant ones. This hierarchical arrangement of purposes will be paralleled on the physiological side by the relationships between primary, secondary, tertiary, and higher orders of retroflex conditioning. There are some reservations, with regard to the rule that all purposes ultimately reduce to instruments of the pleasure-displeasure senses, which are due to the action of the principles of exercise and decay. Nevertheless we can assert correctly that all purposes are based ultimately upon the establishment of pleasant experiences or the removal of unpleasant ones. It should be noted that this statement is not equivalent to the usual hedonistic formula according to which the purpose explicitly represents the pleasantness or escape from unpleasantness as an end. It merely asserts that prior affective experience is in fact the actual determinant of the existence of the purposes, whatever their present content may be.

168. *The Biological Relationships of Purposes*

If the preponderant number of human purposes are developed in relation to fundamental retroflexes in the manner above suggested, it is natural that these purposes should be interpretable as psychical representations of biological instruments in the struggle for existence. All of the retroflexes have an obvious application to the requirements of survival. They represent mechanisms indispensable to the existence of those animal species which manifest flexibility of response. Consequently, there is a close logical relationship between purpose and biological adaptation, which explains the readiness with which such adaptation is interpreted in purposive terms. The fact that nature is so organized as to make life possible and to permit the fulfillment of our purposes seems to be a remarkable coincidence. However, the scientifically enlightening explanation has the converse form, and interprets purposes in terms of their survival values or biological utility. Since our purposes are the creation of evolution, it is not wonderful that the determinants of evolution should be suited to produce and satisfy them.

Now, it must be confessed that a great many human purposes are actually quite lacking in biological utility, and may sometimes be opposed to the interests of survival. The existence of such purposes is readily explained by our theory, without inconsistency with the fact there is a powerful average tendency in the biological direction. In particular circumstances, the retroflex and associative mechanisms, following their normal laws of operation, can produce response systems which are of no use under other circumstances. The original circumstances may in some cases be of such rare occurrence that they are never repeated. Sometimes the responses which are established are not actually valuable in the circumstances which create them, because of some artificial or accidental feature of the experience. Thus, if a person happens to be attacked with an organic pain while playing with a dog, he may develop a lasting aversion to this animal, although in fact there was no repeatable connection between the pain and its external circumstances. The cerebral process usually does not penetrate into the actual causal relationships of the factors which it associatively unites. Another source of non-biological purposes lies in the feature of random activity in the cortex, and in the principles of exercise and decay. The principle of exercise or impression may reinforce the consequences of random action in certain cases without reference to retroflexes, while that of decay may produce the effect of inhibition. Random action is a necessary foundation for learning, but will constantly introduce particular neurological and mental factors which have no survival value, or which may be opposed to a successful struggle for existence. These random phenomena are exactly analogous to the "accidental variations" which lie at the foundation of the Darwinian theory. We cannot expect purposes to be any more rigidly determined by biological exigencies than are other factors in the evolutionary situation.

Still another source of deviations from biological utility in human purposes is to be found in the development of social culture or tradition. Social institutions and customs have their original basis in the same processes which operate in individual learning, but they exhibit a much greater fixity, once they have been established. They therefore create a set of conditions to which the individual member of society must adapt himself, as if they were a part of the order of nature. Changing conditions may render such social institutions biologically worthless or even detrimental, but they may still persist as "survivals of culture" for a long time; and continue to coerce the individuals in society. Frequently, in past history, the whims of a single individual or group of individuals have determined such social conditions, particularly in the form of religion. In the days of the Inquisition, it was biologically advantageous for any man to subscribe to the tenets of the Church, although these tenets in turn may have failed to possess any biological significance.

The development of science has a similar but more salutary effect. Biological and psychological science, in particular, lay bare the actual situations which are involved in the determination of human behavior and thought, so that new forces appear which may become capable of disrupting the entire natural scheme and of setting up a different one in its place. We shall have more to say concerning this point in a concluding chapter.

169. *Phases in the History of Purposes*

From the psychological side, purposes show various stages of development and of simplification. Practically all kinds of human consciousness and action may be regarded as purposive, although the accompanying mental process does not invariably embrace a clear-cut image of the desideratum. When purposes become thoroughly habituated, they tend to be implicit rather than explicit, introspectively. The history of any purpose is paralleled by that of a particular emotional experience. As we have previously suggested, the repetition of such an experience is accompanied by a progressive loss of emotionality, this loss being attributable to the gradual solving of the problem of response adjustment which the situation originally presented. Emotion occurs when we do not know exactly what to do under the given conditions. If the stimulus conditions are repeated a sufficient number of times, and each time we meet them successfully, we eventually develop a rapidly operating form of response which meets the practical situation without hesitation or struggle. Thus, after a man has had a considerable number of successful encounters with bears, they no longer frighten him, presumably because he has learned that the best way in which to escape from one of these animals is by shooting it, and, therefore, he always carries a gun with him when prowling in the woods.

The emotional experience, as we have described it, may be regarded as the prototype of all *action experiences*. Action consists, on the psychological side, of a series of events in consciousness which accompany a *change* in the current mode of cortical adjustment. From the physiological standpoint, we are always acting; so that in one sense all experience is concerned with action; but the process of *volition* seems to involve a change from one kind of response to another, or a decision. Thus, continuing to sit still in a chair, or to walk down the street, may be regarded as non-volitional; but arising from the chair, or ceasing to walk, involves a definite action experience. As we have noted, it is usually said that the *typical action experience* comprises the following sequence of events: (1) a perception, representing some thing or condition in the outside world, (2) the appearance of a certain kinaesthetic image in the margin of consciousness, (3) this image is attended to, or becomes maximally clear, (3a) (the corresponding change in behavior transpires physiologically), (4) the kinaesthetic image is filled out by the sensations arising from this reaction change, (5) other perceptions appear which represent the changed relationship of the organism to the external world.

We perceive that this sequence is a "reduction system" from the emotional experience, produced by the elimination of certain components of the latter. The "image of the desideratum" is absent, together with the succession of "unsuccessful" "instrumental images." The affectivity of the emotional experience has also largely disappeared. Now, we can regard the typical action experience as a characteristic stage in the decay of an emotion, representing complete learning or the establishment of a satisfactory form of response to the given stimuli. The typical action experience itself, however, is also subject to reduction, especially by dropping out of the kinaesthetic image and the accompanying shift of the attention to the latter, and, finally, by the disappearance from conciousness of the initial perception. The first step produces so-called ideo-motor action, whereas the second one yields automatic action. In the latter case, only the consequences of the change in response appear in consciousness.

Now, it would seem that the typical action experience is not explicitly or overtly purposive. The only way in which it could be so regarded would be to consider the kinaesthetic image, which determines the change, to be the purpose. However, there are forms of volitional experience which are intermediate between the typical action form and that of the full-fledged emotion. In such experiences, the desideratum images appear as intermediates between the initial perceptions and the kinaesthetic components.

Even in the case of the typical action experience and the ideo-motor type, a desideratum image can be aroused by association when circumstances demand it. A man may act "without thinking," but if we ask him he can usually give us a "reason" why he behaved in the given manner. It is notorious, however, that such images frequently fail to provide an accurate indication of the real motivating force. Still, if we wish, we can say that such action experiences *have* purposes. It is our thesis that the origin of all fixed action tendencies lies, on the psychological side, in an evolution by reduction from an emotional type of experience, and on the physiological side in the functioning of retroflex or equivalent processes.

170. *Further Examples of Emotional Experience*

In order to illustrate some of the principles which have been considered above, we may apply them to concrete examples. These may well be of a more complex sort than the rather obvious ones which we have already presented, and may suggest some further problems for theoretical treatment. We may deal with some complex emotional cases, the purposes which they include, and the types of action tendency which they lay down.

Let us consider, first, the case of Mr. A, who picks up the evening paper and finds, advertised therein, the latest model of the F—— car, at a price which lies within his means. The pictures and the reading matter are very attractive, and there appears in his consciousness a representation of himself as purchasing and operating one of these cars. His affective state changes immediately from one of indifference to a strongly pleasant one. He reads the advertisement over a number of times, thoroughly enjoying its contents. He rises from his comfortable chair, as if to proceed at once to the agency to make the contemplated purchase; but realizes that they will not be open for business at this time of the night, this act being preceded by appropriate kinaesthetic images. He then proceeds to describe the car and the proposition to his wife, and other mental preparations for the transaction go forward. He images the salesroom and the salesman; and he formulates and reformulates the words which he will use in addressing the latter. The idea of the new car preoccupies his consciousness in various forms throughout the evening, and he finds it very difficult to sleep after he has retired, a phantasmagoria of automobile imaginations chasing constantly through his mind. But even this insomnia is agreeable.

In the morning, Mr. A arises early and hastens to the automobile salesroom, but when he hears the words of the heartless salesman telling him that he cannot secure delivery on the car for a month, the purposive image representing ownership is violently repressed, and the conscious state shifts to one of decided unpleasantness. However, he develops the necessary kinaesthesis to enable him to sign an order, which act presents itself as the only possible way out of the unpleasant situation. From time to time, during the ensuing weeks, Mr. A's consciousness is forcibly invaded by the image of ownership of the new car, always accompanied by an enhancement of pleasantness, although when the idea of the enforced postponement appears there may be a reversal of the affective quality. The purpose persists psychologically. Finally, when the day comes for the delivery of the car, his consciousness is almost exclusively preoccupied by this image, so that he is mentally inefficient at his regular work. He proceeds to the salesroom at the earliest opportunity, and takes possession of the automobile with an experience of exquisite pleasure, which is dulled scarcely at all by the large check which he is compelled to write.

As time goes on, however, the joy of driving and owning the car gradually decreases, until it becomes a matter of affective indifference. The image of the car and the act of operating it no longer appear in consciousness. He arises in the morning, breakfasts, and automatically walks into the garage without any representation of the vehicle before it is actually in front of him. He may even step into it without having any preliminary kinaesthesis. Nevertheless, we can say that, potentially, the purpose of car ownership is still present, although it has degenerated into a habit.

Consider, now, what happens when one day Mr. A steps to the curb where he has left his automobile, and finds that it has disappeared. Something snaps inside of him, there is a rush of diffuse kinaesthesis, a "sinking sensation," and the image of the car becomes a very vivid part of his consciousness. The purpose to regain possession of the car becomes his only thought. "Instrumental images" immediately appear; the police, another car in which to chase the thief, a search of the street, an image of a telepone! This latter dominates his consciousness, and he finds himself hurrying to the nearest spot where he knows a telephone can be found. He calls the police and tells his story. The affectivity throughout this experience is of course strongly unpleasant. Not content with telephoning, he proceeds on foot to the police station where he relates his story in great detail to the sergeant. By now, the affective depression may have subsided to a considerable degree, corresponding with Mr. A's belief that he is doing something effective towards the recovery of his lost vehicle.

He goes home and repeats the description of his experience to the members of his famliy. Every time the telephone bell rings, he experiences a momentary thrill of pleasure, accompanied by an enhancement of the image of regaining the automobile. Finally, the voice is actually that of the police sergeant, who states that the car has been recovered. "What a grand and glorious feeling!" Kinaesthetic images run riot; he seizes his hat and coat and proceeds as rapidly as possible to the police station, where he once more finds himself in the seat of his precious possession, nearly as happy with it as when he first drove it away from the salesroom. For some days, he may experience a considerable pleasure in driving the car, but the affectivity fades more rapidly than before, and, again, the use of the automobile is reduced to the level of a mere habit.

In this case, both the experience of purchasing the new car and of recovering it after it has been stolen, are evidently of an emotional type, and follow the patterns which we have assigned to positive and negative emotions, respectively. The retroflex basis of the desire for a new automobile is, of course, rather intricate. In most people, it is strongly motivated by the "ego complex," which rests upon the entire system of retroflexes. The possession of an automobile improves the individual's standing relatively to that of his fellow-men, assisting him to compete with them on better terms wherever speed of transportation is concerned. It also improves his social prestige. It protects against discomforts of temperature and weather, provides more rapid access to sources of food and amusement, and its facilitation of erotic interests is familiar to everyone as the topic of certain standard forms of humor. We shall develop a theory of complex systems of this sort in later chapters. The *loss* of the car by theft operates upon this same motivational system in a negative or inhibitory fashion, and may be regarded as furnishing a stimulus to the negative retroflex components of the system in question. The loss places the individual again in a position where he is at a relative disadvantage with respect to his fellow-men and deprives him of protection and satisfaction in any field of endeavor, in proportion to the economic value of the loss. The depressing effect is probably mathematically equal to that of the loss of a corresponding amount of money.

Let us now consider the somewhat more complex case of Mr. B, an author, who is writing a book. The purpose consists of a visual image representing a copy of the completed volume, bearing the title and the author's name in gilt letters, with a vague context of felicitations by reviewers, friends, etc. The initial perception or mental occasion for the existence of this purpose is rather intricate. Mr. B is a college teacher who is desirous of promotion. He has a family which he supports with difficulty, and he has been informed that the chances of promotion are increased by literary fruitfulness. Thus the book-writing purpose is subsidiary to other more general purposes which are constituted by images representing improved academic position, a higher standard of living, greater freedom from worry concerning debts, etc. These motives can be traced back through a series of conditioning processes to primitive retroflex forces. The book-writing, or book-written, purpose hovers in consciousness even when these other images are merely latent. Finally, the requisite kinaesthetic patterns appear and are adopted in volition: the would-be author writes, and the purpose is replaced by verbal and other ideas which are involved in composing the work. However, fatigue sensations, difficulty of thought, and other distracting purposes and perceptions, soon impede the flow of the author's ideas, and the process stops temporarily.

Usually, in order that it should begin again, the purpose must reappear, to rearouse the appropriate volitions. After a sufficient number of hours with the pen or typewriter, however, the purpose may drop out of the situation, so that the writing process becomes purely habitual. But after the work is completed and the author has heaved his sigh of relief, the receipt of the first copy of the new book brings intense pleasure. The process of writing a book is unpleasant to the majority of authors, closely resembling that of enforced study to the schoolboy. This is primarily because it demands a sustained inhibition of so many other so-called distracting motives, which would otherwise interfere with it, but partly because continued muscular action in writing or typing is fatiguing or leads to actual nociceptive excitation. The author also places himself in a position where he constantly becomes keenly aware of his own ignorance concerning the subject with regard to which he had originally considered himself to be an expert. In brief, the situation is one which involves *conflict,* a subject which we shall consider in greater detail below.

We may next consider the case of Mr. C, who is an engineer in the employ of a manufacturing firm. He has been assigned the task of designing and constructing a machine for accomplishing a certain result. His immediate purpose in his work consists in a vague imaginal representation of the machine, performing its task successfully. This image is supported by the more comprehensive purpose of gaining and retaining the respect of his employers which, in turn, is subsidiary to earning a living. The latter is supported by his entire system of retroflexes. The immediate purpose gives rise to associative representations, usually of a visual type, which picture the desired mechanism in more distinct form. These images are subjected to a symbolic struggle for existence, either by a purely subjective process of criticism or by reduction to the form of drawings. Such drawings may be made by the inventor himself, or his action may be restricted to verbalization in the form of instructions to a draftsman assistant.

Finally, an intellectually satisfactory design is arrived at, and the drawings are sent to the shop. A complex series of experiences follow for the engineer. Some of these experiences consist, in part, of realizations of the original purpose, and others constitute disappointments, when the design proves to be impracticable in certain respects, or the shop work is not done in accordance with specifications. The consciousness of the inventor fluctuates between pleasantness and unpleasantness in accordance with the course of such events. Ultimately, the machine is completed. Possibly it may operate to his entire satisfaction the first time, but it is far more likely that it will prove to be unsatisfactory in one respect or another. In any event, the first test provides a very pleasurable experience for the inventor, up to the moment when failure may be clearly demonstrated. In the latter case a decided depression of affectivity will naturally result.

Such a machine designer learns, by repeated experiences, not only to become more successful in his work, but to have less affectivity in connection either with success or failure. However, he can never dispense with the necessity for a definite mental representation of the device which he is endeavoring to construct. In a sense, all phases of a designer's work are purposes, because they are delineations of the supposed terminal phase of his experience. The actual drawings on paper are embodiments of purpose.

One of the most complex types of purposive consciousness which can be found in contemporary civilization is that of the business executive at work. His purpose is apt to consist in a mental representation of the balance-sheets of his corporation, showing large profits; or possibly just of managing to "break even," if business is bad. As instrumental to this dominant idea, there are images representing excellent quality in the company's products, contentment among employees, expressions of satisfaction by customers, and so on. The executive's affective state will vary with the fortunes of these ideas in relation to reports and observations of actual facts which come to his attention. In the case of the executive, the mental material is largely verbal in character.

In order not to slight the feminine interests entirely, we may consider the case of a mother with a sick child. Her purpose is a representation of the child in its normal condition and activity. The underlying motivation is complex, involving a fear that the child will be taken from her, and rests upon her "love" for him. Fundamentally, this love consists in a set of habits of caring for the child, which have been built up over a long period of time, under the influence of a diversity of retroflex forces, and the operation of which in this connection we shall consider in further detail below. The purpose, in combination with the perception of the illness of the child, gives rise to images representing remedial procedures, which when attended to lead to corresponding action. If the child recovers, there is great happiness in the realization of the purpose; but if the child succumbs, there is sorrow with accompanying intense unpleasantness. However, caring for the sick can become a non-emotional habit in the case of a nurse, who has continual experiences of this sort. The nurse may have no mental representation of the welfare of the patient, although acting at the same time in a manner best fitted to bring about his rapid recovery.

It will be perceived that the above illustrations of the nature and action of purposes raise numerous questions regarding the exact mechanism of motivation in particular instances. In just what way does the shock of the loss of an automobile, and the powerful influence of this experience upon behavior, derive its force from the retroflex, or other fundamental principles which we have laid down? What is the constitution of "the desire to earn a living," in such terms? How shall we explain motherly love and sorrow? It is our view that these agencies or phenomena can be resolved into complex formations, based essentially upon the primary factors which we have already discussed. However, the development of complicated structures, whether mental or physical, necessarily brings with it certain seemingly new principles, in consequence of the new relationships which are generated by the complexities in question. We shall now proceed to consider some of these more intricate systems and processes.

Chapter XXI

Complexes, and Their Complexity

The term, *complex,* was introduced by Freud to stand primarily for a pathological, or at least an abnormal, combination of *ideas* with emotional or affective tendencies. Since Freud's theory is couched in vague psychological language, his notion of a complex must be regarded as being essentially non-physiological in significance, although, as a rule, his complexes do not prove to be very accessible to introspection. As we have seen, he regards them as denizens of a realm known as the Unconscious, from which position they are supposed to exert important influences upon the introspective consciousness. McDougall [180] and Shand [181] use the term, sentiment, with a similar meaning but without any general implication of abnormality, or of inaccessibility to introspective observation. A complex, according to McDougall, is a sentiment which is more or less *repressed,* or which is in conflict with other sentiments. Other writers extend the meaning of the term, complex, so that it applies to any organization of ideas which embraces or is capable of arousing emotional forms of consciousness, usually involving strong affectivity; a *repressed complex* being a special case. This usage of the word makes it practically synonymous with sentiment.

171. *Various Kinds of Complexes*

Now, if we adhere to the notion of a complex as a psychical entity, we shall be compelled, either to regard it as an abstraction or else to accept the idea of a psychical realm which is broader than that of the introspective consciousness. It seems to be a contradiction in terms to designate a psychical system as *un*conscious, so that the word, *sub*conscious is to be preferred. This term indicates that complexes lie in a psychical manifold which is in some sense under or external to the introspective consciousness, although *adjacent* to the latter, so that important interactions readily occur between the two domains. Such complexes can be regarded as having physiological parallels or counterparts, in the form of cortical neurograms, which possess associative connections with retroflex mechanisms. In other words, the physiological basis of any complex would lie in the record in the nervous system which makes a given afferent excitation a conditioner of a retroflex process. So far as these neurograms are not involved in the cortical synergy of any given moment, they cannot find direct representation in consciousness; and hence if they have any psychical correlates at all, the latter must be relegated to a *sub*conscious.

Every conditioning of a retroflex tendency provides a physiological foundation for a complex in the sense above considered. Thus, the arousal of the pain retroflex by such stimuli as a bear, a fire, or a moving automobile in close proximity to one's body, involves specific complexes. From the psychological angle, all fears and phobias are based upon such complexes. We regard them as pathological if they have no reasonable foundations, but rest upon some accidental experience which may have taken an undue hold upon the individual, because of congenital hypersensitivity or some other biologically irrelevant condition. Complexes may also appear to be pathological if they conflict with other complexes in an unreasonable manner. It is clear that complexes may be based upon beneceptive or pleasant, as well as upon nociceptive or unpleasant retroflex units. From the standpoint of our theory, either hetero- or homosexuality would be a complex, involving the erotic sensibility. Being "in love," sexually, with a particular person is a more specific sentiment of the same sort.

Freud has made the evident mistake in most of his theorizing of claiming that all important complexes have a sexual foundation. Without denying the great importance of the sexual motive, we can easily point out the possibility and existence of many other species of complexes which have no natural relationship whatsoever to eroticism. Complexes based upon pain sensibility are usually more potent than those which are founded upon eroticism. Complexes which rest upon alimentary retroflexes, such as those of hunger and the gustatory sensibilities, also form an independent and powerful class. But we may also have temperature complexes, nausea complexes, respiratory complexes, excretory complexes, and so on. Each of these will be capable of creating emotional experiences and of directing the course of learning by means of the processes which we have already discussed in detail above. Freud groups all of the non-sexual tendencies into a single mass, called the Ego, which he conceives to be opposed to the Libido, but the fact is that the Ego is founded as much upon sex as upon any other tendency. Freud's scheme is really biological and not psychophysiological.

It is evident that complexes can be regarded as the psychical embodiments of continuing fundamental purposes, residing usually in the subconscious, but giving rise to desideratum images in consciousness when they are brought into action by appropriate stimuli. The usual notion of a complex is more or less abstract and ill-defined, like that of the implicit purpose, but establishes more definite relationships with other conceptions than does that of purpose as generally conceived.

172. *Types of Complex Complexes*

Now, the utility of the idea of a complex for our discussion lies in its application to the theory of *intricate* mental and physiological systems of motivation. Such systems involve the operation of *more than one* retroflex mechanism. The nature and activity of what might be described as a uni-emotional complex should be sufficiently clear from our preceding discussion. However, the complexes which are considered by Freud and McDougall practically always involve at least two retroflex tendencies, which are most commonly in conflict with each other. But such a system as the Ego complex involves the entire collection of retroflexes, coöperating, rather than conflicting, with one another. As we have already suggested, the typical Freudian complexes rest upon a contest between erotic excitation and pain. The individual faces a situation in which he is impelled by sexual desire to act in a certain manner, but is inhibited from such action by "fear."

In order to be consistent with the usage of the term, complex, by Freud and McDougall, we shall define it as follows: A complex, psychologically, is a system of ideas (images and perceptions) and affective dispositions, simultaneously involving *more than one* of the latter. A *neurological complex* is a system comprising one or more afferent patterns as simultaneous conditioners of more than one retroflex mechanism. We may reserve the term, sentiment, for any uni-affective system, corresponding on the physiological side to a simple conditioned retroflex, with accompanying motor connections or innervations. This restriction of the meaning of a complex to the really intricate developments of our retroflex-affective theory is justified, not only by previous technical definitions of the term, but by the fact that compound affective systems are actually characterized by great complexity, particularly in their effects, whereas systems involving only a single retroflex or affective disposition are very easy to describe and to understand.

Now, complexes in our special sense may be classified logically in the following manner. Firstly, we may group them in accordance with the *number* of separate retroflex mechanisms or affective dispositions which they embrace: as dual, triple, quadruple, etc. The limit of this series is obviously the total number of such agencies or dispositions which is available: twenty or more. Then, under each of the classes thus established, we must consider the composition of the complex as regards (1) the *signs* of the retroflex-affective factors, i.e., whether they are positive or negative, and (2) the *directions* in which these factors operate.

What is meant by *direction of operation,* above, may be illustrated as follows. Pain is a negative retroflex agency, since it has the fundamental characteristic of *stopping* any form of response which permits it to be excited. On the other hand, it has the effect of *facilitating* responses which *remove* pain stimulation. This facilitation may be only apparent, resting in reality upon the depression of all alternative responses, thus placing the pain-removing response in a dominant position, where it is built up by exercise. At any rate, we can say that the negative agency, pain, acts in a negative direction with regard to pain-permitting responses, but in a positive direction with respect to pain-removing reactions. Similar considerations hold for a positive retroflex agency, such as that of the saccharoceptive (sweetness) system. This latter device operates so as to facilitate responses which are favorable to its excitation and also, virtually, so as to suppress those which are unfavorable to its activity. Although it may not, in fact, directly reduce the conductances of the latter, it accomplishes the same result by placing them in the discard, where the conductances gradually decay, or at any rate never become sufficiently great to compete with those which are established by the direct reinforcing action of the retroflex.

Dual complexes may be divided into three sub-classes, designated as (1) allied, (2) antagonistic, and (3) reciprocal, respectively. The allied type may be either positive or negative. In the former case, two beneceptive or pleasant sensory mechanisms will coöperate to reinforce a given response; whereas in the latter case two nociceptive or unpleasant dispositions will unite to inhibit response. As an example of a positive allied complex, we may consider the case of a fortunate man, who is not only sexually attached to his wife, but is able to regard her as the provider of tasty food. The negative type of allied complex may be illustrated by the case of a medicine which has a bitter taste and a vile smell. There are two other kinds of theoretically possible—and indeed, actual—forms of allied dual complexes, which depend for their existence upon the polarity or direction of retroflex influences. Firstly, a given stimulus (or afferent pattern) may become associated with deprivation from two distinct beneceptive or pleasant excitations. For example, the idea or perception of his father, in the mind of a boy, may be linked with the *removal* of pleasant food and of erotic stimuli, due to the father's capacity as mentor to the child. Secondly, in the case of nociceptive processes, *relief* from two of these may be joined to a single perception. As an illustration of this condition, we may consider the association, with the idea of our family physician, of relief simultaneously from headache and nausea. These latter two forms of allied dual complexes may be designated as *complementary* positive and negative, respectively.

There are also three different forms of *antagonistic dual complexes.* The first involves the simultaneous association with a given idea or stimulus, of one nociceptive and one beneceptive process, so that the stimulus tends to arouse them both simultaneously. As a rule, in this case, the stimulus must be regarded as being compound. One portion of it is associated particularly with the positive retroflex, whereas another portion is connected with the negative one. As an example, we may consider the case of a young man, whose erotic sensibilities are aroused by the sight of a certain girl, but who fears to respond (say, by kissing her) because of the simultaneous appearance of nociceptive pain processes. The fear may be based upon an actual experience of having been slapped in the face, by this particular girl, on a previous occasion, when he attempted to embrace her. In this case, the pain process is particularly associated with the idea of the act of embracing, whereas the sight of the girl arouses the erotic tendency, directly. This form of antagonistic complex may be called *direct,* and is to be contrasted with positive and negative complementary types.

In the *positive complementary* form, a single stimulus is associated simultaneously with the acquisition of a certain pleasure and with the deprivation from either the same or a different pleasure. Thus, in the familiar "gold-digging" operation of the notorious chorus girl, the victim may associate her with erotic gratification, and at the same time with loss of the pleasures of eating when the "girl friend" spends his last cent for him. In the *negative complementary* class, the single stimulus may be associated with the removal of one nociceptive process and the simultaneous application of another one. This frequently happens in the case of medical or surgical treatment, as when a dentist eliminates a toothache by pulling the tooth, or when a headache disappears in consequence of taking bitter medicine.

The *reciprocal* form of complex involves the *coöperation* of positive and negative retroflexes to produce a single harmonious result. The nociceptive action leads one to avoid forms of response which would interfere with the one which is required to obtain the beneceptive stimulation. The most obvious example of this kind of relationship lies in the coöperation of hunger and "taste" with respect to good food. Here the food stands simultaneously for escape from hunger and the acquisition of the pleasures of eating. This type of complex may be designated as *positive reciprocal. Negative reciprocal complexes* involve an aversion which is due to the simultaneous imposition of nociceptive and removal of beneceptive excitations. Thus, a child's father may become an object of such aversion, because he takes away candy and, at the same time, punishes the child with a beating.

It is obvious that triple, quadruple, and higher types of complexes can show an even greater number of varieties. Under the caption of allied, the triple complex will show four classes (as in the case of dual complexes), each class involving three, instead of two, simultaneously operative retroflexes. Under the caption of antagonistic, we find that either the negative or the positive factors must be twinned; so that, at least as regards the number of affective components, the antagonism can never be balanced. Under the caption of reciprocal, there will be two groups, as before, but either the beneceptive or the nociceptive members must predominate numerically. In the class of quadruple complexes, numerical balance will again be possible, and the subdivision of the class will follow lines generally similar to those followed in the case of dual complexes.

173. *Efferent and Psychical Associates of Complexes*

Now, the constitution of physiological complexes is actually much more intricate than would be indicated by the above analysis. Thus far, we have considered a complex as being comprised essentially of an afferent or sensory process in association with two or more retroflexes or affective dispositions. However, in any concrete case, there will also be specific *efferent* processes or mechanisms, which possess definite forms of attachment to the afferent and the retroflex factors. Some of the examples which we have considered above involve such efferent factors, explicitly. In the case of complexes which involve an antagonism of components, there will usually be different and incompatible motor tendencies, which are aroused more or less concomitantly. In the allied and reciprocal forms, a single motor tendency, or group of such tendencies which are harmonious with one another, is set off in a summative manner by the various sensory and retroflex agencies which are concerned. The exact effects which are manifested when a complex is excited will depend upon the quantitative relationships between its several components. At a later point in our discussion, we shall examine some of these effects in detail.

The conscious phenomena which accompany the excitation of a complex will usually be those which we have considered in the previous chapter, dealing with purpose and desire. The allied and reciprocal types of complexes will yield straightforward emotional or purposive action experiences. In the case of antagonistic complexes, there will be a special form of experience which is characterized by hesitation, conflict, worry and similar manifestations. In extreme cases, as in hysteria, there may be anæsthesias, hallucinations, abulias, and other abnormal effects. We shall consider the nature and explanation of some of these phenomena of conflict below.

174. *Higher Order Complexes*

All of the types of complexes which we have thus far considered may be grouped together as complexes of the *first order*. This means that they involve only secondary retroflex action, or a single and initial step of conditioning. The primary retroflexes are aroused directly, although in groups, by associated afferent patterns. On the side of consciousness, there is only one step between the idea or perception and a simple affective sensation. However, it is obvious that, there may be formed, complexes of the second, third, fourth, etc., orders *ad infinitum,* in which lower complexes or sentiments play the same rôle as do the primary retroflexes or sensory affections in the formation of first order complexes. The simplest basis for such higher order complexes lies in the combination of simple sentiments—rather than complexes—which already represent the first stage of conditioning, but have not been tied together by association with a single stimulus. The sentiments which are combined may also be of a higher order than the first. However, a number of lower order *complexes*—each involving more than one affective disposition—may be combined in relation to some new idea or perception, to produce a single higher order complex. Moreover, sentiments may evidently combine side by side with complexes. This process of pyramiding the retroflex forces can go on indefinitely, generating motivated structures having in some cases an astounding intricacy. Probably the most complex of all complexes is that of the ego, which is an integration of the reciprocal type, embodying practically all other complexes as subsidiary components.

As an example of a second order complex, we may consider the hypothetical case of aversion to a doctor who administers medicine and prevents a man from seeing his sweetheart, by orders to stay in quarantine. The medicine conditions bitter taste, while the sweetheart conditions erotic excitation; but the representation of the doctor may not be associated directly with either of these primary dispositions. This is evidently a second order complex of the negative reciprocal type, in which the affective components are simple sentiments. In another case, an aversion might be founded simultaneously upon the fact that a surgeon causes pain and charges a large fee. The pain relationship would be of the first order, but the retroflex connections of the money may be of the third or fourth order and involve an intricate complex. Such a complex may be said to be of *mixed order*. The commonest complexes in everyday life are of this sort.

It is evidently inadvisable to attempt to outline a scheme for all possible forms of complexes, but the above analysis furnishes a terminology which can be applied to all concrete cases. We shall have occasion to illustrate its application further in succeeding chapters.

Chapter XXII

The Ego Complex and Its Operation

The ego complex is the master complex in practically all human personalities. Although we cannot characterize it accurately by means of the epigrammatic formula, "the complex of all complexes," yet it tends to approximate this constitution. We may assert, in any event, that it rests simultaneously upon all of the retroflex or affective dispositions of the psychophysical organism. Its operation should not be considered to be restricted to the production of so-called egotistic behavior—or the exhibition of "vanity"—since this is only one way in which it gains expression, and is probably the least effective way. It should be regarded, on the contrary, as the basis of a consistent effort on the part of the individual to further his own welfare, or that of the species through his instrumentation. It operates under all circumstances and utilizes every available means to this end. However, the ego complex depends for its characteristic form in the human constitution, upon a competitive or social environment.

175. *Stimuli to the Ego Complex*

Like other complexes, the ego complex involves a definite afferent pattern which conditions the excitation of a system of retroflex-affective forces. If we speak more accurately, we shall have to state that it involves a *series* of such afferent patterns. These patterns represent oneself in a competitive relationship to other selves. Usually, this relationship is economic, but it may be "social," sexual, or of an artificial character, as in games, or other forms of sport.

The series of patterns may be defined by its terminal members, which represent the highest degree of *superiority* and of *inferiority,* respectively. In the first case, the self is imaged or perceived as being wholly victorious over other selves, while in the second it is represented as vanquished. For the moment, we may neglect the question as to the precise sensory materials and configurations which are concerned in these patterns. These will differ from one individual to another, while their "meaning," or relations to the retroflex system, response, and consciousness remain substantially the same.

The superiority pattern is usually a conditioner of all of the positive retroflex systems, without exception; while the inferiority pattern is a conditioner of the entire group of negative retroflex mechanisms. Moreover, the superiority idea represents removal from the possibility of excitation of nociceptive channels, whereas the inferiority idea stands for the impossibility of stimulating beneceptive processes. These connections may be direct in some cases, but are more likely to follow a complicated linkage. The exact arrangement of these relationships, to constitute the ego complex, may be supposed to have been determined as the composite result of almost innumerable experiences of various sorts, which have demonstrated that a man must win in the struggle with his fellow men, if he is to secure the pleasures of life; and that if he fails, he will be subjected to physical displeasures. Thus, the ego complex carries with it the facilitative and inhibitory power of all of the retroflex mechanisms. This explains its remarkable ability, when strongly aroused, to modify response, to mold character, and to predominate over other complexes or sentiments.

There are a number of very comprehensive complexes which ordinarily function as important components of the ego complex. Among these may be mentioned the *money complex* and the *position complex.* Money may operate as a conditioner of all of the retroflexes without reference to the self, because its presence has been connected with the stimulation of pleasure mechanisms and its absence with the operation of mechanisms of displeasure. Social or economic position may be the practical equivalent of money. Now the stimulus pattern of the ego complex seems to have a general or abstract form which can be filled in at different times with particular, concrete items with respect to which the given individual may be superior or inferior. Thus, he may perceive that he has more or less money than another man, that his academic position is better or worse, that his health or strength are superior or inferior, as the case may be. Money, position and health are stimuli to powerful complexes by themselves, but operate in a different and distinctive manner as stimuli to an appropriately constituted ego complex.

The ego complex, considered in this manner as an affective system which has a generalized stimulus or afferent pattern in which the individual compares himself with other men, is liable to seize upon any attribute which is capable of being inserted in such a pattern. However, it is an essential condition that the attribute in question should be regarded by the individual as being either desired or disapproved by his fellows. But there are very few human qualities or relationships which cannot be viewed in this way. Whether a man is large or small, light or dark, clean-shaven or with a full beard, may become a matter of egoistic comparison. In fact, the ego complex manifests a tendency to select as its stimulus any possible characteristic of men which is supposedly possessed in favorable measure by the owner of the complex. We shall consider the mechanism of this process below.

176. *The Development of the Ego Complex*

Let us first consider in some detail the manner in which the ego complex is probably developed in the individual. To do this, it will be necessary to show how the pleasure mechanisms become associated with the pattern which represents superiority to one's fellow men, and how the displeasure systems have been linked with the opposite representation. In general, we can see that experience will naturally tend to bring about such an association, because whenever the individual is actually superior he will be placed in a situation where his pleasure sensibilities can readily be stimulated, and when he is inferior, his displeasure mechanisms are apt to be excited. Some difficulty may appear, in cases where the individual has never had the actual experience of perceiving himself to be superior, so that he cannot have learned its accompaniments directly.

This difficulty cannot, however, exist simultaneously for both the superiority and the inferiority patterns. The majority of people start life in an inferior position. While in this position they actually experience the displeasures and the deprivations from pleasure which naturally go with it, so that the negative retroflexes become associated by direct processes with the inferiority picture. A man's perception that he is at the bottom of the social and economic ladder is thus enabled to act in accordance with the general law of nociceptive excitations, or to inhibit those forms of response which permit this perception to be aroused. If the individual has actually developed such sensibility, he will exhibit the form of behavior which is usually attributed to "ambition." He will show a tendency to break away from his routine habits and lines of work, and to try something new. In proportion as his trials are successful, his perception of inferiority will disappear, and the forms of response which bring about this relief will be allowed to continue without interference from this source.

The process which we have just described will ordinarily be reinforced by the action of the superiority aspect of the ego complex. Even if the individual has never succeeded in anything, it can safely be presumed that he has learned the consequences of success through moral instruction, reading or observation of the lives of others. The general picture of superiority, as presented in the biography of a great man or in a story, has been associated through the medium of words with ideas of reward or pleasure. Separate beneceptive agencies may have become associated with the superiority idea in this manner at different times, until all of them have eventually been given attachments to it. Observation shows any man that in order to win and retain a wife he must have a reasonably good standing in the economic system, so that chances of sexual success are dependent upon his relations of superiority or inferiority to his fellows. In the case of the woman, the same situation arises with regard to beauty or some other personal characteristic.

Education also contributes in an important degree to the establishment of connections between the picture of inferiority and the negative affective dispositions. We learn in school, from books and from observation, that he who is inferior must suffer pain, hunger and exposure. Some children who are "born with a silver spoon in their mouths" may require such instruction in order to learn the meaning of inferiority at all. It is notorious that such children are apt to have less ambition and to make less progress in life through their own efforts than are those who experience a greater initial struggle.

177. *The Mechanism of the Ego Complex*

The joint operation of the two phases of the ego complex may be described technically as follows. As we have noted above, the inferiority component will tend to discourage forms of response which permit the individual to continue to perceive or to think about his own subordination. The inhibitory action, here, is actually that of the inborn negative retroflex mechanisms, which are set off by excitation of the associated inferiority pattern. On the physiological side, the process is simply that of the conditioned negative retroflex, although the history and structure of the conditioning may be very complex. The individual acts as if he were endeavoring to escape from the perception of his own unimportance. His trials may be really quite haphazard, consisting merely in a refusal to continue in any given line of work, but he is likely to improve his standing in the community if the process continues, since it is probable that he will eventually find some mode of adjustment which relieves him from the annoying inferiority stimulus. This mode will tend to persist. It is even likely that he may come across a form of behavior which will not only change his social position for the better, but will cause it to improve progressively. In this way, for example, he may learn to be industrious, honest or even "intelligent."

The superiority phase of the ego complex will operate in exactly the same general manner as does a positive retroflex process. The perception by the individual of his own superiority—or improvement in position—increases the tendency of accompanying forms of response to recur. Thus, this perception, or the accompanying physiological process, leads to the stamping in of the line of conduct which makes the perception possible. Whenever he does anything which results in the perception of his own relative greatness, this form of action will be especially facilitated. He will thus tend more and more to place himself in a position where he constantly recognizes his own ascendency.

The apparently dual constitution of the ego complex must be regarded as representing an actual feature of its history and neurological basis. Its two aspects, however, are rather intimately united. Sometimes the operation of the complex appears to be explicable in terms of a continuous scale of social greatness, upon which the individual's concept of himself slides up or down. If the movement is in the direction of greater attainment, the effects are of the positive retroflex character, whereas retrogression produces negative retroflex phenomena. However, it is probable that we shall have to interpret this principle as meaning that the individual compares his present state with a previous one; and if the direction of the comparison is favorable to the present moment there is a positive effect, whereas, if it is unfavorable, the action is negative. Nevertheless, the two phases frequently combine in an integral manner. Thus, a man may simultaneously perceive himself to be inferior in one respect and superior in another, with the result that the two phases counteract each other and produce a resultant effect. This involves no novel principle, since the concurrent direct excitation of nociceptive and beneceptive channels will combine algebraically in this same way. However, the relationship between the two opposite phases of the ego complex must necessarily be more intimate than that between two anatomically separate retroflex mechanisms such as those of pain and of sweetness; which might be brought into operation simultaneously, say, when biting a piece of candy with a decayed tooth.

It will be seen that the ego complex, as described above, has a component which suggests the "inferiority complex" of Adler.[182] However, Adler's cases are to be interpreted in a special manner, and one which throws further light upon the normal interrelations of the two contrasted phases of the ego complex. Adler's typical patients possess—or, at least, suppose themselves to possess—some organic abnormality, such as lameness, which is constantly before their minds and thus constitutes an unescapable perception of inferiority. Such particularly unfortunate individuals will be subjected continuously, and to a much greater extent than will normal individuals, to the inhibitory action of the inferiority motive. The ordinary man is presented with inferiority stimuli only at intervals, whereas a man who has a defect stamped upon his person, can scarcely avoid perceiving his misfortune much more frequently. Consequently, his unrest will be greater than in the case of the normal person, and he may be expected, other things equal, to make more rapid progress than is usual, in a practical demonstration of *superiority*. Since it is impossible for him to place himself beyond recognition of his defect, his ambition will never be satisfied. However, actual success may settle him in certain lines of endeavor, because of the positive reinforcement which comes with his awareness of his own achievements. Thus, the superiority phase may counteract the tendency of the inferiority phase to produce endless striving and dissatisfaction.

178. *Mental Phenomena Due to the Ego Complex*

The psychical processes which accompany the operations of the ego complex are exactly what should be expected on the basis of the psychophysical theory which we have laid down in previous chapters. The perception of inferiority as a phenomenon in consciousness is extremely unpleasant, and goes with a blocking of concurrent volitional tendencies and the appearance of imagery representing alternative forms of action. The negative affection is attributable to the arousal of the negative retroflex processes, which involve a lowering of the conductances of current responses, so that different ones tend to supervene. The nature of the new imagery will vary, of course, with the character of the individual. In the case of a man of low type who is insulted by another man while he is at his work, there will be a cessation of the labor impulse, followed by direct kinaesthetic representations, which may result in a physical attack upon the offender. The emotion will be that of *anger,* for reasons which we shall discuss below.

In the case of a man of higher intellectual development, the instrumental images may be visual or auditory, as well as kinaesthetic. They will represent various alternative schemes for avoiding the inferiority perception. These images may then suggest elaborate sequences of kinaesthetic representation, which are required to bring about their realization. In other words, the inferiority perception arouses subsidiary purposes, which then operate in the manner which we have previously characterized. In the highest type of individual, these purposes or ideas will be subjected to criticism within consciousness, and may disappear from the scene without leading to action. This effect appears to be referable to the fact that through association these rejected schemes give rise to other ideas which stimulate the inferiority rather than the superiority motive. Thus when a man of refinement is insulted, he may think of striking the offending party; but this thought will arouse in his mind the idea that such action is of an inferior sort. He therefore retaliates with words, or merely walks away.

In complex situations, this process of internal criticism may continue over a protracted period of time, one image after another being rejected because its associations do not represent any improvement in the perceptual situation with which the individual mind is faced. The inferiority and the superiority phases of the ego complex coöperate with each other in determining the course of this process. Those ideas will be selected for action which promise the greatest exaltation of the self or the least abasement. The process actually follows the requirements of the retroflex theory very precisely. If a certain idea gives rise by association to a representation which makes the given individual appear inferior, this representation will be accompanied by a negative retroflex process which involves a progressive reduction of the conductance for the corresponding form of response. This is on the assumption that an associatively aroused image of inferiority will carry with it an intracerebral excitation of the same neurogram which is set off via direct sensory channels, so that the conditioned retroflex action will also be set off. The form of behavior which is represented mentally by the idea under criticism is, of course, not actually occurring as a full-fledged response. However, certain cerebral factors in this response must be active, and it is to be expected that these will come under the influence of the retroflex forces. If the latter are negative, the activity of the cerebral factors in question will be repressed, with an accompanying disappearance of the corresponding volitional representations in consciousness.

On the other hand, if the idea which is aroused gives rise, by association, to images which stand for an improvement in the ego's position, consequences of an opposite kind will ensue. In this case, the incipient response will be subject to a conductance *increase,* so that it will probably become overt. This will correspond to the adoption of the given idea in consciousness as a basis for action. The contemplation of an idea which brings forth representations of inferiority, or retrogression, will naturally be unpleasant, whereas, an idea having associations of an opposite character should be pleasant. These requirements are met by the facts of experience. The practical results of this thought process for the man's welfare will depend upon the degree to which his associations correspond with the facts in his environment which bear upon his success. If his associations have been determined by actual causal relationships between the items which are represented in his thought, his decisions will be wise, and he will achieve the best possible realization of his ego ambitions. If his associations are fantastic, he will probably fail. But the internal process of the mind is the same in either case.

If any degree of success is attained, the ego complex is at least partially satisfied, and, to this extent, will tend to lose representation in consciousness, because of the disappearance of the stimulus. Thus, when a man obtains an appointment for which he has worked continuously over a long period of years, the idea of the appointment will soon become dormant, so far as introspective evidence is concerned. However, the complex is still in existence, as is shown by the phenomena which will appear if the individual is notified of his dismissal from the once coveted position. The pattern of this notification is that of intense inferiority, much greater than that which stimulated him to his efforts to obtain the appointment in the first instance. He recognizes that tenure of office usually permits a man to retain his job, even if he does not perform its duties as efficiently as he did in the beginning. Moreover, he has based his standard of living upon the seeming security of his position, and now he is faced with the apparent necessity of lowering it. The image of possible further promotion, which has previously hovered before his mind, is dashed to the ground. He is older than he was when he first gained his appointment, and should be further advanced, and now he is thrust back, at least temporarily, into the class of individuals of minimum economic status.

Under these circumstances, the individual loses interest in all of the routine labors of his office, and even his customary amusements cease to have any attraction for him. His mind dwells constantly upon means for restoring his position, and of justifying himself in the eyes of his employers and associates. He seeks conferences with those whom he believes can make decisions, or exert influence in his favor. He argues his case over and over in his own mind. Every perception and associatively aroused idea which may accidentally appear within his consciousness is treated in the light of the dominant ego purpose. If the idea in question makes no contribution to the task of restoring the lost prestige, it will be thrust aside. If it emphasizes this loss, a keen pang of unpleasantness will be experienced. If it contributes a seemingly valuable factor to the program of restoration, there will be a momentary pleasantness, or a partial relief from the general state of affective depression which is characteristic of the continuing experience.

Thus, when he sees or thinks of a friend who does not yet know of his disgrace, or contemplates some incident which was associated with his original promotion, the affective state becomes very negative. The next time that this same idea occurs, however, the increase of unpleasantness will be much less marked and may be entirely absent; but a new one may bring the same effect. The conditioned negative retroflex process is busying itself with the work of wiping out the response systems which have been built up with respect to the lost job. Conductances are lowered promiscuously. After this process has continued over a period of days or weeks, according to the nature of the case, the disturbance will have gradually subsided. The actual forms of behavior which have been adopted and carried through will have exhausted all of the alternatives which the individual is capable of imagining. If the situation is actually such as to make impossible the restoration of his original status, he will have been forced to repress all of the lines of response which can be directed toward regaining it. He will, therefore, follow other alternatives, which involve the quest for a different place of employment. He will pursue these other alternatives until success is achieved, and he again places himself, at least relatively, beyond the annoying action of the inferiority stimulus.

It will be perceived that this course of experience conforms to our general specification of an emotion. The notice of dismissal is the initial stimulus, corresponding to the bear in our original example. The purpose or desideratum image which runs through the experience is that of the removal of the undesired condition. This purpose arouses a flood of instrumental images and forms of action, which finally lead to success, consisting in release from the original disturbing perception. The emotion is obviously of the negative type, characterized by unpleasantness throughout its course, but by positive pleasure at its successful termination. This pleasure will be very keen if the individual is successful in recouping his original position. If he suddenly learns that there has been a reconsideration in his favor, his consciousness will be violently suffused with positive affection. In this event, positive retroflexes are set off by the resulting superiority perception, and these begin the task of restoring the depressed conductances of the response systems which are connected with his original work. These conductances go up rapidly, because of their preformation along the required lines. There may be, also, an after-effect, analogous to Sherringtonian "successive spinal induction": a rebound from inhibition when the inhibiting agency suddenly ceases to act.

179. *Vanity and "Egotism"*

As we have previously noted, the possession of an ego complex does not necessarily imply egotism or vanity in the ordinary sense of these terms. "Egotism" usually signifies an undue tendency on the part of the individual to praise himself and his own accomplishments. This may merely be a verbal instrument which he employs as a practical means to self-aggrandizement, to influence his fellow men so that they will contribute to his actual welfare. In other cases, which are the most typical of "egotism," the process of self-praise is a direct defense against the man's persuasion of his own inferiority, and provides an immediate stimulus to his superiority motive. If *other* men praised him or minimized his deficiencies, he would naturally perceive these facts as gratifications of the ego motive; and if his mental constitution is appropriate, his own words may have a very similar effect upon himself. This is a method of artificial escape from the disturbing idea of being a failure in life, which will be successful in proportion as the individual is dominated by verbal imagery. If he has a disposition to regard all propositions as true just because they are uttered, he will find this device to be quite effective, particularly if his economic status is good, apart from any actual contribution which may be made to it by his own efforts. On the other hand, a man who is skeptical of all verbal formulae, even of those which are the developments of his own thought, will be unlikely to exhibit true vanity, and will praise himself only to gain some ulterior end.

180. *Reflex Expression of the Ego Complex*

The fundamental retroflex associates of the inferiority phase of the ego complex are probably those of pain and hunger. It is therefore to be expected that the usual reflex accompaniments of these sensory excitations will appear when the inferiority motive is aroused. Accordingly, there should be an innervation of the sympathetic nervous system, with the characteristic syndrome: adrenal secretion, increased heart rate, higher blood-pressure, glycosuria, etc. There may also be phenomena of anger, which we have regarded as a reflex expression of proprioceptive pain or discomfort. The hunger sensation appears to have no specific reflex expression, except possibly in the gastric contractions. Sensations similar to those of hunger, usually assigned to "nervous indigestion," quite uniformly accompany the state of "worry" which goes with undue excitation of the inferiority motive.

The case of anger is of particular interest. If we assume in accordance with the observations of Watson,[183] that the natural stimulus to the anger reaction lies in the forcible restraint of the spontaneous movements of the organism, then we should expect that any "insulting" situation would arouse it. When a man is "fired" from his job, he is stopped from doing the things which he is accustomed to do; his normal volitions are blocked, and anger may well ensue. However, we must not rely upon the mere analogy which exists between this situation and that of the physical restraint of muscular action. We must show that in the case of an individual who reacts in this manner, there has actually been an experience in which the muscular restraint has been associated with a perception of inferiority. This is something which is almost certain to occur in the lives of most men, who at one time or another will have suffered the sensory and perceptual discomforts of physical combat.

181. *Extensions of the Ego Complex*

Although the ego complex is itself very intricate, it can obviously furnish a foundation for the development of further complexes. In fact, it is probably the most potent of all generators of fixed likings and aversions, in the adult mind. A man who has been dismissed from a desirable job will, thereafter, normally detest his previous employers and those among his fellow workers who gained as a consequence of his dismissal. He may escape this consequence if he is sufficiently introspective and regards such reactions as tokens of motivational inferiority, but even a psychologist cannot fail to comply with valid laws of motivation. It may also be true that other experiences have established contrary tendencies which will not be entirely undone by the inferiority feeling. The persons and things which are associated with a man's rise in the world become objects of particular liking. The ego complex can establish such likings and aversions very rapidly and effectively, because of the great power of its retroflex connections.

One of the most interesting extensions of the ego complex lies in its attachment to the representation, in a man's mind, of the members of his own family. If his relations with his wife and his children are reasonably free from disturbing influences, his thoughts concerning them become identified in effect with those regarding himself. The same proposition applies, of course, to the mental attitude of the wife or children. This egoistic unity of the family must be attributed to a complex array of forces, but its most important determinant lies in the commonness of their struggle against the rest of the world. The progress of each member means progress for the entire group. From the standpoint of the head of a harmonious family, the other members appear as constant encouragers of his superiority motive. If he should suffer misfortune at any time, the people who share in the fruits of his labor endeavor to encourage him by disparaging his opponents and trying to make him see "the bright side" of things. Insofar as this does not occur, he will feel no pride in his family and will be inclined to contrast their welfare with his own.

182. *Other-regarding Complexes*

Since it is our view that the ego motives are products of experience rather than of specific hereditary disposition, the way is left quite open for the development of complexes or sentiments which are directly concerned with the welfare of persons other than oneself. It is true, of course, that the individual can be influenced only by his own pleasures and displeasures; never directly by those of others. But this does not prevent him from acquiring habits of response which benefit other people. The only requirement is that such responses should have been accompanied at some time by the excitation of a positive retroflex, or, on the other hand, that behavior which is contrary to the welfare of others should have been punished. Ordinarily, these requirements are met only in a social situation, which imposes artificial conditions.

The most primitive situation of this kind is undoubtedly that of sexual courtship, in which the suitor must please the object of his desire in order that it should be possible for him to obtain erotic gratification. However, the concomitance of altruistic behavior and sexual excitation will stamp in a habit of such conduct, which will continue even when no erotic stimulation occurs. Similarly, society arbitrarily offers rewards and imposes punishments which are directed towards the control of human behavior along altruistic lines. The man who serves his fellow men most efficiently is most likely to have the happiest life and thus to form the habit of other-regarding action. On the other hand, the grossly selfish individual is very likely to suffer pain in consequence of the nature of his conduct, and, thus, to be inhibited and, possibly, reformed in consequence. The ideal wife or mother forms an *alter complex,* which centers about the perceptions of the persons whom she loves. With regard to her husband, her habits may be determined in part by erotic forces, but they will also depend upon her reliance upon him for economic support. If she does not please him, she is in danger of nociceptive stimulation, either direct or indirect; but if she caters to his welfare the accompaniments are more likely to be beneceptive. With regard to the child, she is influenced by the natural reactions of the latter, which are apt to arouse negative retroflex processes through association, if he is not properly cared for. The attitude of the father also plays an important part in determining the behavior of the mother toward her children.

The ego complex, itself, can obviously operate so as to generate altruistic responses. In a community where selfishness is regarded as an exceptionally inferior form of conduct, the ego complex will naturally discourage selfish acts, and encourage altruistic ones. The devices which are used by Christian theology and ethics to inculcate unselfishness are based quite evidently upon the principles of our theory. These teachings link the idea of unselfishness with those of future rewards on this earth and in Heaven, while selfishness is attached to the opposite notions.

183. *The Foundations of Sympathy*

The development of altruistic behavior has frequently been explained on the basis of a supposedly innate disposition called *sympathy*. It is assumed that the manifestations of particular emotions or feelings by others arouse these same feelings in oneself. There can be no doubt as to the existence of a strong tendency in this direction in certain individuals, although the feelings which are generated by the observation of emotional expressions in others are not uniformly such as to duplicate those which exist in the mind of the first party. For example, expressions of anger on the face of a stranger are likely to result in fear on the part of the observer. This is obviously because such expressions have previously been noted as precursors of punishment, inflicted by the angry person. The mechanism of sympathy itself can be explained in the same manner. If we see another person crying, this perception arouses images which have been connected in previous experiences with similar unpleasant feelings of our own. The principle which is involved here is evidently the familiar one of the conditioned retroflex. It is, of course, true that the visual perception of emotional expression on the face of another person does not resemble the proprioceptive representation of the same expression on one's own face. Nevertheless, these two patterns have presumably been linked together by experience, so that we know how feeling angry "looks," or *vice versa*.

Sympathy may tend to make people act in a similar manner under the same circumstances, but will not necessarily generate altruistic motives. However, sympathy may frequently be concomitant with an attachment or identification of other persons with one's own ego concept, which provides an effective basis for the development of altruistic action. When we perceive the pain of some person who is dear to us, and who forms an important component of our own standing in the community, we are likely to react to the situation as one which threatens our status and which thus constitutes an inferiority stimulus. The good Samaritan who helps a suffering stranger does so, not, primarily, because of sympathy, but because his mental constitution happens to be such that the perception of another person in unfortunate circumstances arouses the image of himself in the same condition. Hence his behavior is such as to eliminate the unpleasant association by alleviating the sufferings of the stranger.

McDougall [184] claims that the reactions of men to the opinions of their fellow men cannot be explained, as we have endeavored to do, simply on the basis of their bearing upon material welfare, or even anticipated blame or praise. He points out that some men "are prepared to sacrifice ease and enjoyments of every kind—in fact, all of the good things of life—if only they may achieve posthumous fame." Rare as this sort of behavior actually is, its existence is not necessarily inconsistent with the views which we have propounded in the present book. Habits of working for fame may be based upon past experiences of praise and blame and ultimately upon associations with sensory pleasure or displeasure, without the individual being aware of this fact in later life. The power of such habits may well be sufficient in certain cases to enable them to dominate over action tendencies which have a more direct relationship to contemplated rewards or unpleasantness. McDougall's difficulty is due to his manner of thinking in terms of a psychological hedonism of the future. There is no theoretical reason why a man may not make choices which are automatically determined by the nature of past experience, but which involve a great sacrifice of concrete future values, just because these values are not actually envisaged and even if they were, might fail to have any decisive bearing upon the motivational outcome.

184. *The Phenomenon of Perseveration*

One of the most interesting aspects of the operation of the ego complex as we have described it above, is the degree of *perseveration* [185] of its excitement when once it has been stimulated. This appears to be a general characteristic of perceptually aroused retroflexes. Primary retroflex action tends to cease quickly when the direct sensory stimulus is removed, but the effects of an insult or a fright continue for a long time after the actual stimuli have disappeared. The cause of this perseveration is to be sought in the properties of cortical neurograms and their interactions with the retroflex mechanisms with which they have become associated as conditioners. Originally, the retroflexes are arousable only by direct afferent nerve currents, but when they become conditioned they can be set off in consequence of the activity of particular cortical units or systems. These cortical factors are set into action themselves by appropriate afferent currents, but they are also capable of self-excitation, or at least of being aroused intracortically by agencies of association. The phenomenon which we call memory involves the continued activity of cortical neurograms, after the afferent excitations which have produced them have subsided.

It seems likely that neurograms which have become associated with retroflex processes will be particularly excitable, because their own activity sets off important subcortical energies which have a powerful back-action upon the cortex. At any rate, the effects which are actually observed in consciousness and response bear out this idea, and it appears that the degree of perseveration of the activity of such neurograms increases in proportion to the intensity of the retroflex processes which are involved. In the case of the ego complex, the simultaneous involvement of the entire system of pleasure-displeasure dispositions, brings about a very powerful and persistent continuation of the specific cortical activity which sets this system into operation. It appears that the inferiority neurogram will tend to operate continuously after it has once been excited until its complement, the superiority neurogram, is sufficiently aroused, in which case a sort of neutralization will occur and the entire system will be set at rest again. Similar phenomena are observable in the case of the conditioned erotic retroflexes, as we shall see in the next chapter.

Another conception which has particular importance in studies upon the quantitative interrelations of separate motives, is that of the *degree* to which a given perception or neurogram can arouse a specified affective disposition or retroflex. We may suppose each retroflex mechanism to have a certain intrinsic potency, which varies in magnitude from one mechanism to another. Thus, the potencies of the erotic and the pain systems are very great compared with those of the saccharoceptive or bitter systems. However, among the various conditioners of the erotic sensibilities, some may be highly effective, whereas others operate only weakly; certain visual perceptions may be intensely voluptuous while other appeals to the eye may be only moderately excitatory. Similarly, in the case of the ego complex, some perceptions arouse the system strongly and others affect it only slightly. The explanation of this quantitative variation in the power of a conditioner over a conditioned mechanism probably lies in the quantitative aspect of the original experience which was responsible for the formation of the association. Thus, if a certain perception accompanies the powerful arousal of sensory pain, the perception will be endowed with a very potent influence over the pain retroflex. However, if the initial sensory experience in connection with a given perception or afferent pattern, is of low intensity, the pattern will have only a slight power over the retroflex. In other words, the reproduction of the original retroflex excitation by the conditioning stimulus is quantitative as well as qualitative.

Chapter XXIII

Sexual Motivation

As we have previously noted, Freud's analysis of human motives leads him to divide them into two classes, the sexual and the egoistic. Although we shall not subscribe to this exclusively bipartite classification, the erotic and ego complexes certainly do form the most powerful motivational systems in the normal adult human being, and in the majority of abnormal adults. It is also true, as emphasized in the Freudian psychology, that there is a very considerable amount of conflict between these two systems, thus placing them in rather sharp contrast. They are, however, capable of alliance as well as of interference with each other. The normal ego complex certainly derives a great deal of its force from erotic retroflexes, and exaltation or abasement of the self is frequently experienced with respect to success in affairs of love, or with regard to one's supposed attractiveness to the opposite sex in general.

185. *The Problem of Innate Erotic Pattern Sensibility*

Sexual motivation is less complex as a rule than that which is controlled by the ego. It occurs mainly through the instrumentation of sentiments, although these are commonly of a higher order than the second (order). Although sexual complexes are not uncommon, they are usually regarded as being abnormal. Many erotic sentiments which are quite straightforward from the psychological standpoint are also viewed by the ordinary man as being pathological. We have already presented a conception of the physiological nature of the sexual mechanism in considerable detail in previous chapters, and need not repeat this discussion here.

We have advocated the view that the hereditary make-up of the erotic system in human beings comprises a powerful positive retroflex arrangement, together with certain fairly simple reflex expressions, both of these being set off primarily only by excitation of the erogenous zones. We have combated the view that the erotic mechanism is congenitally conditioned upon any particular stimulus pattern, such as those of vision and touch, which are ordinarily responsible in the mature individual for the arousal of sexual interest. Consequently, it is necessary to attribute responses of this sort, which involve perception as a primary factor in consciousness, to "experience."

This doctrine is contrary to that of McDougall,[186] who says that "the sex instinct illustrates very clearly a much neglected fact of instinct . . . namely, that an instinct is not only an innate disposition to act and to feel in a more or less specific manner, but is also an innate disposition to perceive or perceptually discriminate those things towards which such reactions are demanded by the welfare of the species." This supposedly innate "cognitive disposition" is assumed to render the individual capable of recognizing members of the opposite sex without having had any previous experience regarding their anatomical peculiarities. Indeed, McDougall indicates,[187] specifically: " . . . the view which seems to me indisputably correct—namely, that the perception by the eye of the human form is one, and the principal one, of several innately provided roads of excitement of the sex-instinct. Not only so; but also, we are, I submit, compelled to believe that the instinct is differentiated in the two sexes on the afferent side; in such a way that in the normal male the presentation of the female form is an effective excitant; for the female that of the male form." McDougall inveighs against the so-called "sense-stimulus theories," according to which all specific human erotic sensibilities are derived from a purely sensory origin through "experience."

Now, this raises a question to which it is not possible to give an absolutely confident answer in the present state of our knowledge, but the facts which are at hand seem to be capable of explanation without requiring the assumption of such a complicated innate mechanism as is demanded by McDougall's view. These facts indicate, on the part of the sexual sensibility, a lack of specific congenital attachment to patterns of excitation, or particular objects, and great flexibility in the formation of such attachments, rather than the reverse. It must be acknowledged, of course, that the sight of the undraped female form exerts a powerful emotional influence upon most men, and tends to arouse erotic feeling. However, it is notorious that the state of *partial* undress or exposure of feminine beauty—particularly in harmony with the mode of the day as regards under-attire—is even more stimulating. Feminine limbs in silken hosiery and high-heeled slippers, together with the unnatural posture of the whole body which is produced by high heels, appeal to the modern man far more strongly than do the natural textures and postures of the female body. Certainly, there can be no congenital predisposition to delight in such creations of fashion; and if the power of their appeal to the erotic motive can be explained on the basis of experiences which have produced a perversion of natural tastes, then it would seem equally plausible to account for the attractiveness of the unadorned female figure in the same manner.

McDougall refers to supposed instances in which boys, who are devoid of all acquired sexual knowledge, are fascinated by the sight or idea of the feminine outline. He does not, however, present any actual cases and discuss them in detail. It is highly dubious whether any such cases can really be demonstrated, since the difficulty of proving that a child has actually had no instruction regarding sexual matters is excessively great. Parents have a tendency to view their own children as exceptionally innocent, but an intimate study of the lives of children shows that their general inquisitiveness leads them to discover important facts concerning sex at a very early age. It is not necessary to go as far as Freud does, and regard the infant boy as a little satyr, in order to believe that the ideal of childish innocence is greatly overdone in the popular mind.

The ease with which the sexual impulse is "perverted" is an indication that even if it does have innate perceptual associates, these are extremely vague and weakly attached. Furthermore, this facility of perversion shows that conditioning of the erotic retroflex occurs very readily and effectively. These facts lead us to suspect that the mechanism of "perversion" is identical with that which establishes the so-called normal or unperverted interests. The commonest of these perversions is of course that of homosexuality, or an erotic attachment to persons of the same sex. Some authorities believe that this may have a congenital basis, but the evidence is rather that it is due to some early association between sexual sensation and the perception of a person of one's own sex,—possibly oneself. If a powerful attraction of this sort can be brought about by experience, why should we not endeavor to account for the genesis of normal heterosexuality in the same manner?

186. *Modes of Conditioning the Erotic Retroflex*

There are a number of different kinds of influences which may be supposed to fix erotic sensibilities upon the opposite sex. The crudest of these—and the one which probably operates most infrequently in laying the foundations for the preference—is an initial full-fledged sexual relationship with a person of the opposite sex. If we imagine a society in which older men are quite free to seduce young girls; and older women to instruct the male youths in sexual intercourse, it is quite easy to see how heterosexuality could be established and maintained. The primary prerequisite in this situation is the psychophysiological fact that a higher degree of sexual pleasure is secured by contact of the male with the female genitalia than by any other easily realizable mechanical process. Sophisticated adults could be relied upon to ascertain this fact experimentally, and the method of erotic indulgence which produced the greatest total amount of pleasure in the long run would predominate. The custom in India [188] of the marriage of immature girls to mature men provides a partial example of such a situation.

It is furthermore stated, however, that Indian customs are designed to inculcate sexual interest at the earliest possible age, masturbation being encouraged, particularly among the girls. Observation and instruction, whether in the home or elsewhere, should suffice to condition the sexual impulse heterosexually without actual physical intercourse. Practically every child becomes conversant in the home with the fact that his father and mother have intimate bodily relationships; they sleep in the same bed or in the same room, and appear before each other freely in states of undress. Curiosity as to the process of birth, brings the child to explanations which reveal the sexual relationship directly or indirectly. It is quite common, also, for small boys and girls to examine each other's sexual parts, probably not in the beginning from erotic interest, but rather from curiosity. Such experiences, and the thoughts which arise from them, may not be associated at first with sexual feeling, but are available for such association at a later time, through the medium of language.

It is well-known that erotic sensibility exists in both sexes, and particularly in the male, from birth; not being limited, as is sometimes supposed, to the period following puberty. Handling of the sex organs or accidental irritations are apt to arouse erotic feeling at any age, and this becomes a source of great interest and inquiry on the part of the child. He will learn eventually, either from his companions or by reading, that these sensations are normally associated with relations to the opposite sex. Now, it may seem that a mere process of verbal association is not adequate to account for the linking together of sexual sensations and specific perceptions or ideas, to generate such a powerful motive as that of heterosexual attraction. However, an unbiased application of the principles which have been laid down in the present book will show that the facts can be explained in this manner. Suppose that a boy is already familiar with the nature of erotic sensation, but has not attached it to any particular object—with the exception of his own sex organs. It is not at all uncommon for boys to discover the phenomenon of erection and the pleasure which accompanies excitation of the penis when it is in this condition, without having the least idea as to the significance of these facts. No images of the female form are spontaneously aroused.

Let us suppose, however, that such a boy is instructed by an older boy, or possibly by his father, that the purpose of the penis lies in copulation with a female, which yields very powerful pleasurable sensations. Immediately, the female acquires transcendent interest because, through the instrumentation of words, she has been made a conditioner of the boy's erotic retroflex. The mere statement to an individual that a person of the opposite sex can give the greatest erotic pleasure will suffice to make such a person the object of powerful erotic interest. The mechanism which is involved here is essentially the same as that which is obviously operative with respect to negative retroflex systems. If you are told by someone whose truthfulness you do not doubt, that a certain man intends to inflict bodily damage upon you, you immediately become afraid of this man. In this case, purely verbal associations are sufficient to condition the pain retroflex upon a particular object. The same process can occur just as readily in relation to sex.

187. *The Establishment of Sexual Habits*

McDougall's account of the sexual instinct implies that human beings have an innate tendency, apart from all instruction or learning, to carry out the movements of embrace, of establishing appropriate union of the sex organs, and of copulation. We have already indicated that some of these movements are probably reflex in character. This certainly applies to the copulatory rhythm, and in all probability to the associated embrace (flexion of the arms about an object). However, a man's initial experiences with the sexual relationship are frequently characterized by considerable clumsiness, and sometimes even by temporary impotency. It does not seem that any very elaborate scheme of "chain reflexes," or of inborn conative dispositions is required to account for the development of normal sexual responses. The physical nature of the process is familiar to all men—if not to all women—prior to their first practical experiences. The woman, because of her passivity, does not require any particular knowledge; but she can only be satisfied when the behavior of the man is biologically appropriate, which is not equally true for the man. The fact that the greatest pleasure ensues when normal relationships are established is a guarantee that the habits which are eventually formed will usually be of the normal type.

It may happen, however, in certain cases that the normal act is not attempted, or that the greatest pleasure is felt in some deviation from the normal. In this case the habits which are formed will tend to defeat the biological function of reproduction, but their formation does not involve any novel process of "perversion," because it is based upon exactly the same principles as those which account for the normal result. We have only to ascertain the causes which have changed the conditions for the greatest pleasure, or have limited the individual's experiments with the sexual relationship. There is a strong tendency for the earliest kind of behavior which has brought gratification to be "stamped in" so strongly that other response tendencies are unable to oust it. If a given form of response acquires a conductance value which makes it markedly superior to any alternative, the only chance that it will be displaced lies in its coming under the influence of some inhibitory force. Sexual gratification is not an appetitional process in the technical sense of this term, since it is not characterized by a shifting from one response form to another, but rather by a consistent adherence to the form which is yielding whatever pleasure may actually be realized.

Three logically distinct processes are involved in either normal or abnormal developments of the sexual impulse. First, there is the process of "stamping in" or of raising the conductances of certain lines of response: forming habits, usually sexual but sometimes not. Second, there is the process of conditioning the erotic *retro*flex upon certain images or afferent patterns. In the normal case, these will be representations of the opposite sex, but there is no innate limitation of their possible character. This does not form or constitute any habit or response, but simply makes the given image capable of bringing about conductance increases within the cortex at some future time, or of bringing pleasure in consciousness apart from the arousal of bodily sexual feeling. The object which is associated in this manner with the erotic retroflex becomes in itself a source of pleasure. We express this fact that the visual perception is intrinsically affective by calling it "beautiful." Third, there is the process of conditioning the sexual *re*flexes. The object in question will normally gain the power to set off the reflexes of erection and of preliminary secretion. In this case direct erotic sensations will be experienced some time after the perception of the object has appeared in consciousness. If these sensations are at all intense they will be strongly pleasant, but their pleasantness must be considered as having a separate causation from that which accompanies the exciting perception.

188. *Sexual "Perversions"*

In some persons, women as well as men, a visual or ordinary tactual stimulus may become capable of producing the consummatory reflexes and the experience of the orgasm. This high degree of susceptibility would tend to be established by an initial experience in which the orgasm was produced artificially—as by masturbation—while contemplating the voluptuous object. Even in the absence of this extreme susceptibility, the conditioning visual or tactual stimuli strongly facilitate those which may be derived directly from the sex organs, so that they enable the consummatory reflexes to occur more quickly and powerfully. The ordinary course of sexual relations does not tend to establish visual susceptibilities of this sort to any great extent, because the final sexual act so commonly occurs in darkness, or in such close proximity to the body of the mate that clear vision is obscured. However, under these conditions, the patterns of tactual excitation due to bodily contact play a similar rôle.

The forms of voluntary response which are established by the action of the erotic retroflex are logically independent of the outcome of the conditioning process, whether this applies to the reflexes or the retroflex. It is in accordance with the principles of retroflex theory that those responses predominate which have accompanied the greatest amount of pleasure or affection. Ordinarily, these responses will be such as to minister to the function of reproduction, or, at least, will have some similarity to the reactions which are required to this end. However, the necessity for such biological relevancy is to be looked for in environmental and general organic circumstances, rather than in the demands of the inborn nervous mechanisms. Erotic excitation can facilitate any form of response whatsoever, which may happen to be concomitant with it. If the erotic process happens to accompany some wholly irrelevant form of response, this latter may later exhibit a strange potency. Many cases of so-called *compulsion* can be explained on this basis.

Two types of such compulsions can be distinguished. In one type the compulsory act or the accompanying perceptions are highly pleasant and there may be organic sexual feeling. In the other type, the act does not seem to be impelled by a normal course of conscious desire, but is of an irresistible ideo-motor nature, so far as consciousness is concerned. The misdeeds of certain wrong-doers, who have been studied by Dr. Healy,[189] "are forced, as it were, by something in themselves, not of themselves . . . the effect of the conduct in question is not in any ordinary sense pleasurable to the misdoers, nor do they regard it as such. . . .

It would seem that students of human motives should long since have been attracted to this curious phenomenon of conduct, because, results not being even contemplated as pleasurable, ordinary motives are not plainly involved."

Now, in the absence of special disturbing conditions we should expect sexually generated compulsions to be of the first type, defined above. The fixation of the response would be accompanied by a conditioning of the reflexes and retroflexes and the consequences of these processes would appear simultaneously in consciousness. Three cases (quoted by McDougall [190]) from Dr. Healy's writings demonstrate this condition. In one case, which may serve as an example, a boy was invited to take a drive with a stranger, who made it clear to him that the horse and buggy in which they were riding was stolen. Simultaneously, he stimulated the boy sexually, and later the boy manifested an irresistible passion for stealing horses and buggies. This passion definitely involved pleasurable temptation and sexual feeling, together with memories of the original incident. In this case the erotically facilitated response may be considered to be that of getting into and riding in a buggy, the sight of the outfit arousing the sexual retroflex process at the same time, so that each repetition of the response would involve further conductance increase, even in excess of that which would result from the normal exercise of the habit.

In cases of the second type, where the element of desire is apparently absent, we must suppose that some disturbing influence has intervened, either to prevent the conditioning process, or to neutralize its results. It is entirely conceivable that some individuals may be incapable of having their erotic retroflexes and reflexes conditioned. The development of their habits will still be influenced by erotic stimuli, but they will form no fixed sentiments in the erotic sphere. It seems likely that a low conditionability of retroflexes is a primary feature and cause of the moron level of intelligence among human beings. The moron can learn very effectively through sensory pain and pleasure, but scarcely at all on a basis provided by association of the inhibitory and facilitative agencies with ideas and perceptions. However, an even more probable explanation of desireless compulsions lies in the notion that the conditioning, which once existed, has been rendered ineffective because of conflict with an opposed tendency, such as that of pain. Such neutralization of the affective component might take place without having any important effect upon the established response paths, since the two depend upon distinct neurological connections. We shall consider the details of such processes of conflict in later chapters.

McDougall's explanation of the facts of erotic compulsion exhibits a general similarity to the one which we advocate, although it differs in certain important details. He says:[191] " . . . The sexual impulse drives the patient to a particular kind of action undertaken at the time when it was first aroused to activity. Owing to the performance of the act of stealing during a state of obscure sexual excitement, when the sexual impulse is still blind, and when circumstances do not lead it on to its natural goal and expression, its energy becomes diverted into the activity of stealing; thereafter it is apt to follow a similar course, whenever the impulse is excited." Our present point of view would differ from that of McDougall in the following respects. Firstly, the kleptomania as a habit does not require the sexual impulse as a support when once the habit has been formed. Secondly, although the first sexual experience may be the most effective one, as regards *conditioning* of the erotic retroflex, the facilitative effect of erotic excitation upon concurrent responses can be observed in equal measure throughout life. Thirdly, the cases cited by Dr. Healy do not involve any actual *perversion,* or distortion of a supposedly innate tendency, but follow the same principles as operate in the establishment of the so-called normal sexual habits.

189. *Sublimation*

The principle that erotic excitation can facilitate any form of response whatsoever, lies at the basis of the process which is known in the Freudian psychology as *sublima-*

tion. As indicated by McDougall, the mechanism of sublimation is the same as that of so-called perversions of the behavior type, which we have just discussed; but it does not ordinarily involve sensory perversion. We call the process sublimation when the responses which are facilitated are beneficial to society, or even to the individual himself in the long run, although they are not contributory to the function of reproduction. Sublimation is usually engineered by conditioned rather than by primary retroflex action. Thus, the work of a great poet or philosopher may be directly reinforced by his love for a woman, but less frequently by sensory sexual feeling. This may be attributed to the fact that the sensory process is ephemeral and requires a preoccupation of the response system with the means for its production and continuation, whereas the conditioned excitation is highly perseverative and may readily accompany any form of response whatsoever, however complicated.

190. *Falling and Being "In Love"*

The process of falling in love is to be regarded as one of conditioning the sexual retroflex. Ordinarily, the first steps in this conditioning will be secondary or tertiary rather than primary. If we assume that the individual's eroticism has already been conditioned upon the "general idea" of the opposite sex, then falling in love with a particular member of that sex will involve the operation of the more general stimulus upon the more specific one. In the case of a man, women in general excite erotic feeling, so that when some particular woman does this by exemplifying her species, her representation becomes associated in a tertiary manner with the erotic sensibility. However, the process may follow a number of different courses, and is susceptible of various interpretations. It is to be noted, in the first place, that for the normal heterosexual male, feminine "looks" vary widely in their ability to stimulate erotic interest, apart from the obvious question of the degree of exposure of the bodily form. Each man has his own special conception of ideal feminine beauty, and the degree to which a particular woman approximates this ideal, determines the intensity of her appeal to his erotic interest.

If we were to adopt McDougall's assumptions, we might regard this ideal as representing the inborn concept of Woman, but it is notorious that such ideals vary a great deal between men, and particularly between different races. Thus, the Chinese demand abnormally small feet, and in some savage tribes hypertrophied buttocks are the style. The preferences of the occidental male appear to be determined by standards of art and of contemporary fashion, as presented in magazines and on the stage. These standards demand that a woman's breasts should be firmly hemispherical, whereas the actually prevalent anatomical condition is the pendant form, which seems quite unaesthetic. The features should be of the so-called regular type, with a bloom of rouge on the cheeks and plenty of red on the lips. The current mode of dressing the hair is a prime essential of beauty of face, although a man's taste may lag behind the fashion of the day. A woman's ankles should be slender, but her calves well-developed. It is our view that all of these requirements as to visual pattern are quite arbitrary, so far as innate erotic tendencies are concerned, although it is quite possible that aesthetic principles in general are derived to some extent from inborn properties of the visual nervous system.

However, when a man meets a woman who very closely approximates his ideal of beauty, his erotic retroflex will be aroused very strongly; so that her particular characteristics will become conditioners of this same mechanism. If her name happens to be Mary, this word will acquire peculiar sweetness. The particular inflection of her voice will become fascinatingly pleasant. Even if her mentality is actually of inferior grade, the things which she says will prove to be profoundly interesting. In short, all of her attributes are idealized or endowed with beauty. The basis of this effect can evidently be identical with that which establishes the more general ideal.

We may assume that in this phase of love at first sight —if it be such—there has, as yet, been no appreciable arousal of the sexual *re*flexes, although no doubt it would be possible to detect such effects in the majority of actual cases. Let us suppose, however, that—as seems to be the rule in modern times—the man is quickly successful in embracing and kissing the object of his interest. If he has never previously approached a woman in this manner, his impulse may be attributed to the simple association of the idea of this kind of behavior with that of an attractive woman, this association having been established in consequence of his reading, conversation, and observation of the acts of others, either in real life, or on the stage and screen. If he is experienced in courtship, his impulse will have been reinforced by the pleasure which pursuing it has yielded in the past. At any rate, it is likely that he will experience pleasure when he follows it under the circumstances which we are considering; and there is almost certain to be a strong arousal of the preliminary sexual reflexes, as a consequence of the physical contact. This effect is not to be attributed to any innate disposition, but to the fact that such physical intimacy approximates, to some extent, the man's conception of the conditions for final erotic gratification. It is possible that kissing appeals to a primary erogenous sensibility, particularly in the woman. It is by no means universally true that the act of embracing an attractive woman will arouse physical excitement in men, but it is the general rule. In case this effect does occur, there will presumably be a direct erotic feeling of considerable intensity, which will then establish a *primary* association between the representation of the particular woman and the erotic retroflex. This places the erotic interest in this woman upon a very firm and reliable basis.

The mental phenomena which accompany the state of being in love may be suggested somewhat as follows. Consciousness is dominated by the beautiful image of the loved one. There are intensely persistent kinaesthetic images, representing the processes of "petting." The pleasurable experiences with the sweetheart are reviewed repeatedly in memory, proving themselves to be highly delectable, and ordinarily inducing physical sexual excitement. Other ideas and habitual purposes are crowded out of the mind. The experience is typical of the positive *emotion,* although the exact character of the love emotion will depend upon the particular circumstances in which the individual finds himself. If he is subject to no other source of motivation, he will stay with the loved woman, maintaining the forms of response which yield pleasure, discovering others which are even more fruitful hedonically, which lead finally to sexual union and the consummatory reflexes. The almost transcendent intensity of the pleasure which normally accompanies the initial erotic gratification of masculine sex love can be relied upon to establish a powerful habit of continuing or repeating the responses which have produced this result.

In actual life, however, there is nearly always interference with continuous progress along such an ideal line of least resistance (or greatest conductance). The love process is liable to be stopped by hunger, as a direct sensation; or it may be interrupted indirectly by the same inhibitory agency operating via the demands of the economic system. It is also normally impeded by resistance on the part of the woman, and by fears which are aroused in the mind of the man. Consequently, there is *conflict,* and the emotional process becomes complex. In this case, the emotion is liable to assume a negative aspect and become highly unpleasant. We may attribute the unpleasantness to two possible causes: first, the inhibiting of the erotically generated response systems, and second, the apparently nociceptive character of low intensity sexual excitement. As a negative emotion, the experience is concerned with the purpose of getting rid of the conditions which interfere with a continuation of love responses and the accompanying forms of consciousness; the instrumental images which arise being directed towards this end.

191. *Idealizations of Love*

The notion that being in love is merely a state of having one's eroticism conditioned upon the representation of a particular person, has been attacked by McDougall [192] as being "ridiculously inadequate." He believes that we must add the influence of the so-called parental instinct, which underlies the "tender emotion," and that when the sex impulse operates without the check of the tender emotion, it is apt to be accompanied by impulses to brutality. A primary difficulty with this suggestion consists in the fact that a careful analysis of parental behavior does not justify the idea that it is based upon a specific innate tendency, so that the so-called tender emotion must look for a basis in some more complex considerations. It is evident that the theory which has been developed in the present book implies tenderness just as much as it does brutality, as parts of sexual behavior. The actual course which the impulse takes must depend upon the specific experiences of the given individual. It seems questionable whether we should regard love as being debased by supposing it to be derived entirely from sexual susceptibility, which is associated with the most important of all biological functions and with the greatest pleasures of life; but this problem is irrelevant from the psychological standpoint.

The retroflex theory is wholly consistent with the possibility that, under certain conditions, the love experiences should be quite free from sensory erotic feeling, although this is certainly not the usual state of affairs. The causes of such freedom from obvious eroticism would be the same as those which we have considered above in our discussion of desireless compulsions. Exclusively Platonic love will either be found to involve some form of conflict, or else to have no erotic foundation at all, being a friendship based upon considerations of expediency which rest upon other retroflexes.

However, we may note the following principles in this connection. Where a succession of associative or conditioning relationships is concerned, the image of the primary affective sensation is less likely to appear, in proportion to the number of such associative links. It is probable that the reflexes which normally follow from the primary sensory excitation are subject to a similar rule. Thus, erotic feeling and sexual reflex reactions will be weaker in tertiary than in secondary sexual retroflex processes, and still weaker in quaternary, etc. The general idea of the female has a strong erotic quality for the male, that of his virgin sweetheart has lesser degree of such quality, and that of the things which he likes for her sake, even a lower degree. The over-all "form quality" of any consciousness or experience is a function of the integral make-up of the experience, depending more upon the perceptions which are involved than upon the nature of the fundamental retroflex. The latter contributes only the sign and intensity of the affectivity. The feeling quality which is characteristic of the primary retroflex will tend to disappear in proportion as the sensations which normally accompany the latter are submerged in other factors. This should suffice to account for the introspective difference between what McDougall calls "tender emotion" and lust.

The explanation of the tendency for sexual love to assume a so-called ideal form, involving altruistic conduct on the part of the lover, is not far to seek. The average woman relies, or hopes to rely, upon her sexual attractiveness to provide her with economic support. She has been taught and has observed that this relationship exists in society, particularly in the married state. She therefore reacts to a man's approaches in such a manner as to make it necessary for him to cater to her general welfare if he is to succeed in his love-making. Her essentially erotic interests are usually much weaker than those of the male, particularly if she is a virgin; and if she is distinctly not a virgin, she has learned by actual experience to associate sexual submission with economic reward. Hence the male suitor finds himself repulsed until he acts generously and altruistically toward the object of his desire; and when he gains pleasure through such behavior, the altruistic forms of response will be stamped in and become habits. This line of reasoning applies not only to material gifts and financial support, but also their representation in flattery, or in terms of the supposed position of the woman in the social scale. By ministering to her non-erotic pleasures, the man can make himself a stimulus to non-erotic retroflexes in the female constitution. The same kind of reasoning can of course be applied to the case of the woman, who is also a suitor in her own way; but she is apt to have recourse primarily to more directly sexual means of appeal. Her mind is preoccupied with methods of increasing her physical beauty and attractiveness, which lead her to adopt eagerly the modern forms of attire which expose her figure to the male gaze.

But, of course, this is not the whole story about love. In the beginning, love is a powerful emotion and, hence, a process which goes with the laying down of new habits of response with respect to the loved person. As time goes on, this emotionality gradually subsides, and in the state of marriage is almost certain to disappear entirely. Agencies, other than the erotic, assume preëminent importance in the marital relationships, and the interests of the two persons become identified egoistically, as we have seen, in a struggle for existence with the rest of the world. Love, as a process of mutual helpfulness—largely without feeling—is the solid foundation of a successful matrimonial association. There is still, however, a basis for emotional experience. If the habitually loved person is threatened with death, injury, or economic misfortune, the whole system of response which has been woven around this person, seems to be subjected to an inhibitory influence, which causes extreme unpleasantness. This mental state of sorrowing love is characterized by extreme tenderness, in the McDougallian sense, and is expressed in behavior by efforts to protect and to restore the welfare of the loved object. We shall consider this process in greater detail at a later point in our argument. The intensity of this reaction is a test for the existence of true, practical, love.

192. *Causes of Erotic Unrest and Instability*

If we compare the theoretical implications of our retroflex theory with the actual facts of human life, we find that they seem to demand that men's choices should be rather *less* in accordance with a principle of hedonism than they actually are. Thus, in the domain of sex, it might be anticipated that continued sexual relations with a single person of the opposite sex should produce practically indestructible habits of response to this person. The formation and continuance of such habits can actually be demonstrated in many instances and is particularly characteristic of the female sex. However, in the male, there seems to be a very powerful urge towards variety, and a tendency for the reactions to a given mate to disappear when her capacity to yield exceptional pleasure has waned. Although such waning appears to be a definite characteristic of masculine erotic sensibility, the lapse of the perceptual aspect of the pleasure in connection with one woman does not interfere with the possibility of high affective intensity in a new series of experiences with a different woman.

The processes which are involved in such cases are quite complex. We must be careful to remember, in the first place, that habits or responses are conditional upon the operation of a specific stimulus. Thus, no matter how firmly fixed a reaction with respect to a particular stimulus may be, this reaction will not occur if the stimulus is absent. Thus, if a man's wife goes to the country, his responses to her will presumably remain dormant, and the high degree of fixity of the corresponding neural mechanisms will not necessarily interfere with the establishment of similar responses to some other woman whom he may meet and find to be attractive in the absence of his wife. Conflict between the two sets of responses will occur only when the wife returns and the man is required to sustain both relationships simultaneously. If he is prevented by moral scruples from making the new attachment, this will be due to an additional factor in his habitual make-up which is not at all a necessary part of his system of response to his wife.

The renewal of intense erotic pleasure which accompanies relations with "strange" women is to be attributed to the processes of conductance increase which go with the novel patterns of sensory excitation belonging to the new experiences. A new system of impressions and responses is being built up; and, as we have previously noted, the pleasure of novelty is enhanced remarkably when combined with positive retroflex action. The intensity of the new pleasures means the rapid production of a firmly intrenched set of responses. If the man's responses to his wife have been subject to interference, say, by the fear of further offspring, or an unwillingness on her part, there will have been considerable decay in the corresponding conductances. Consequently, it would not be at all surprising if the new set of habits should actually become more powerful than the older ones, so that when the moment of conflict comes they will be capable of overcoming the latter. As we shall see in a later chapter, such conflict tends to resolve itself in an "all or none" manner; the erotic conditioning must attach itself to one or the other of two stimuli and not simultaneously to both.

Another complexity of this sort of situation lies in the definition of the "stimuli" which are involved. Strictly speaking, a person of the opposite sex is not a single patterned stimulus, but a *class* of such stimuli having an indefinitely large number of members, since each view of such a person is at least slightly different from each other view. There is a bond of general similarity and association which ties all of the different aspects of the same person together. But the actually operative stimulus is frequently even more complex than this, since it may involve the total situation in which the person appears. It is a familiar fact that the erotic effect of exposure of the female form depends upon the circumstances under which such exposure occurs. Thus a well-formed girl in bathing attire becomes an object of much more intense interest on the street or in a drawing room than on the beach. The wholly nude figure of a living model, posing before a class of male art students, may be quite devoid of direct erotic appeal, because of the environment in which it is set. Hence, when we find a man's interest in a woman changing, we must first inquire whether she provides the same stimulus as before. If she has changed physically, by growing old or fat or thin, she may have become erotically unrecognizable. Or the original object with which the man fell in love may have been the woman in a certain situation, against a definite background, or in a certain supposed relationship to himself, all these things having changed. The simplest application of this idea is to the common case of the woman who wins a man's interest by cosmetics and style, and drops these to become slovenly in their subsequent home life. Or the alteration may occur in the auditory rather than in the visual domain, as when the dove changes to a shrew.

Chapter XXIV

The Conflict of Motives

In preceding chapters, we have considered how certain more or less unitary tendencies of response are generated in the individual, and how these units operate when left substantially to their own devices. However, the fact that there is actually a multiplicity of such motivational units means that cases must arise in which two or more of them will tend to be set off simultaneously. In such cases, there are evidently two general possibilities: first, that the concurrent motives will combine harmoniously to yield a resultant form of behavior, or, on the other hand, that they will *conflict* with one another. In this latter case, the reaction outcome may be some sort of compromise or difference between the two concurrent tendencies, but it is more likely to involve an "all or none" choice between them, in which one of the systems is wholly set aside. These possibilities correspond to those which Sherrington has discussed as applying to the simultaneous arousal of two or more reflex tendencies, although the effects and principles which are involved will presumably be more complicated in the case of cortically controlled responses.

193. *Examples of Conflict*

We can distinguish a number of different kinds and degrees of motivational conflict. The simplest is that between two simple response mechanisms, or habits, considered without reference to their retroflex associations. These mechanisms may conceivably be aroused by the same stimulus, but the conflict is ordinarily dependent upon the simultaneous presence of two stimuli, belonging respectively to the two response systems. On account of the perseveration of afferent excitations, particularly in the cortex, the two stimuli do not need to be exactly concurrent in order that there should be conflict. In fact, they may be separated by very considerable periods of time, and still come into competitive relationship. Nearly every change in the form of our response demands at least a momentary conflict, because the behavior which is going on at the time must be displaced under the influence of a new stimulus. Consider, for example, the case of a workman who is busy at his bench, but is interrupted by the ringing of a telephone bell. He drops his work, lifts the receiver, and says, "Hello." The response to the work has momentarily been inhibited and replaced by that to the ringing of the telephone.

Conflicts of this sort may seem to be too common and simple to require much attention. However, we need to explain how it is that the ringing of the telephone bell can interfere with a form of action which is already established. Under certain conditions it may not succeed in doing this. If, as we say, the man is particularly "interested" in his work, he may disregard the bell, or may even fail altogether to hear it. Under some circumstances, he may be set definitely *not* to react to the telephone, as when he is anticipating a disagreeable communication: say, a dun for the payment of an account. In this case, there will be no conflict, or, at any rate, the latter will not appear in the overt reactions of the individual.

A more troublesome kind of conflict is generated when the interruption of a given line of response is not merely momentary, but when there is a demand that the new form of behavior should be adopted permanently or semi-permanently. Consider the case of a man at work upon the construction of a radio set, which he is anxious to complete; and suppose that the voice over the telephone is that of his employer, requesting that he proceed immediately with some business duties away from home. In this situation, the experience is apt to involve considerable unpleasantness, and it may even take on an emotional aspect. The conflict here will not merely be between two preformed channels of response, but between two distinct stimulus situations and their relationships to retroflex forces. The man desires to retain the stimuli which are provided by his radio set and its advancing construction; and wishes to avoid being placed in a situation where these stimuli become inaccessible. However, the nature of the telephone call and its associations may be such as to prevail over his radio interests. He depends upon the approval of his employer for his opportunity to earn a livelihood, and so he abandons his work upon the radio set and sets off on the business trip. At least during the early part of the journey, his consciousness is strongly unpleasant, and is dominated by ideas of the work which he has been compelled to leave behind.

194. *The Psychophysical Mechanism of Conflict*

What is the neurological basis of such a conflict? It is evident, in the first place, that sentiments or complexes are involved, in addition to habits. Possibly the tendency to construct radio sets can be regarded as a pure habit in certain individuals. Obedience to the wishes of one's employer may also be viewed as a habit, but is conceived rather more satisfactorily as the manifestation of a sentiment or complex, since the concrete forms of response which are required may vary so widely from one time to another. The employer, or his voice, is a conditioner of the employee's ego complex. Hence the active factors in the conflict are this complex—with its retroflex components—and the radio-set-building habit. The latter, in all probability, also has retroflex associates, but we may neglect them for the time being.

The situation which develops as a consequence of the telephone call presents a stimulus pattern that excites the inferiority phase of the ego complex, when the man continues to work on his radio set, or contemplates this form of behavior. This situation associatively arouses representations of disobedience to the employer, of being dismissed, sacrificing his salary, etc. Consequently, the tendency to continue work on the radio is progressively inhibited, and the commands of the employer are obeyed. However, the radio ideas continue in the mind and suffer further depression—with concomitant negative affectivity—as the individual goes on his business journey. Nevertheless, the radio-set-building habit has not been entirely destroyed by this process since, when the business has been completed, the man returns eagerly to this amusement.

It is evident that a conflict of this sort involves a rather intricate group of effects. It is improbable that the ego complex operates exclusively by reducing the conductances which correspond to the radio-set-building habit. It seems necessary to suppose that it also acts by increasing the intensity of the nerve currents, or afferent-side cortical activities, which are aroused by its associated stimuli. Hence, the telephone call may dominate over the incompleted radio set as a stimulus, in accordance with the Sherringtonian principle that the more intensive of two afferent excitations tends to be victorious in a contest. This effect of the retroflex upon the afferent energy of the response system may be regarded as having the same basis as the phenomenon of perseveration of affect-laden images which we have discussed in a previous chapter. The true retroflex action, however, may be going on at the same time, depressing the radio-set-building response system, and decreasing its liability to recur even under appropriate stimulus conditions. This inhibition will tend to occur in proportion as the afferent intensity of the new stimulus is insufficient to overcome that to the radio work, and the conductance decrease will accumulate until there is a cessation of the set-building activity and the business responses are enabled to supervene.

When the man has returned to the presence of his radio, he may find that he takes increased pleasure in resuming work upon it. This may be accounted for by the ready restorability of the depressed conductances, or perhaps adequately by the mere fact that they have been lowered, so that there is a greater available range for conductance increase than before. This corresponds to Sherrington's principle of successive spinal induction, according to which a process of inhibition paves the way for a particularly active process of excitation after the source of the inhibition has been removed. However, the exact course of the experience will depend upon whether the inhibitory stimulus, or its perseverating effect on the afferent side of the cortex, has actually been eliminated. If the individual has failed to satisfy the requirements of the business demand, he will still be agitated by these inhibitory influences, and he will not enjoy the resumption of his interrupted pastime. On the other hand, if he has discharged the business duties to his complete satisfaction, he will have that delightful form of experience which is known as a "clear conscience," which permits him to enjoy his other occupations to the maximum possible degree.

A process somewhat different from that discussed above would occur if the telephone call represented the possibility of some experience for which the individual was nursing a powerful positive desire. Suppose, for example, that the call comes from a sweetheart whom he has not seen for some time. In this case, the radio work is apt to be dropped promptly, with a complete elimination of the ideas which represent its continuation. While our hero is on his way to keep his engagement, his consciousness is preoccupied with imaginations concerning his beloved one, rather than regarding the situation which he is leaving behind, and the state of mind is highly pleasant. In such a case, it would appear that the afferent intensity of the newly aroused response is very much greater than that of the one which has been ousted, so that there is no necessity for a depression of the conductances of the latter. The conductances of the sweetheart-seeking response are being increased by a conditioned retroflex process as they operate, these increases underlying the pleasantness which characterizes the corresponding consciousness. However, after the meeting, with its joys, is over and our hero is once more at home, the sight of his incompleted radio set will set off the interrupted responses again. His mind, however, may still be dominated by thoughts about his sweetheart, which may possibly lead to complications, such as a conditioning of his erotic interests by radio.

195. *The Determinants of Afferent Intensity in Cortical Response*

It would appear from the above discussion that mental conflict, with concomitant unhappiness, is dependent upon a state of fairly close balance between competing response tendencies, where one, or possibly both of these tendencies, involves negative retroflex activities (by conditioning). If the afferent-side intensity of one of the response excitations is markedly greater than that of the other, the situation can resolve itself without conductance decrease. We cannot assume that, in general, the replacement of one form of response by another necessarily involves a depression of conductances, although it may possibly entail inhibition in some other sense. The mere shifting from one kind of action to another does not, necessarily, alter the facility with which these same forms of action may be aroused at a later time, when appropriate stimulus conditions are present. The process must usually be explained in terms of changes in the stimulus configuration, rather than in the essential conductances. If the stimulus to a given response, R, disappears, the reaction will also fail, no matter how great the conductance may be. In the case of conflicts such as we have considered above, the stimulus situation or pattern suddenly alters in such a manner that two effective stimuli are present simultaneously. There must then be a dynamic competition between these two stimuli to determine which one shall become dominant.

Now, in perceptual situations such as we are considering here, the effective intensity of a stimulus cannot be identified with the physical forcefulness of the action upon the sense-organ. The visual picture of a radio set may be just as forceful, optically, as that of a sweetheart's face. The intensity of the illumination upon these two objects will be quite irrelevant; and the effective intensity factor is to be sought in the afferent-side cortical processes which are aroused. These will depend, presumably, upon the degree of preparation of the corresponding cortical neurogram patterns, and the forcefulness of the associated retroflex processes.

Closely allied to these considerations is the fact that, to a very large extent, the cortex selects and defines its own stimuli. At any time, a great many individual forces are actually operating upon the sensory receptive areas of the body which have no appreciable influence upon the concurrent responses. We express this fact from the psychological standpoint by saying that we "pay no attention" to these stimulus components. While the man is working upon his radio set he does not notice the noises of passing automobiles, or objects in his visual field which are irrelevant to the interest of the moment. Thus, the cortex selects, out of the total ensemble of afferent currents which are presented to it, certain groups which correspond to concomitant predispositions. This cortical action, the parallel of the directing or control of attention, may be attributed to the same influences which underlie affective perseveration.

One way of stating the principle which seems to hold here is that the relationship of conditioning between a retroflex and the cortical process corresponding to perception is *mutual.* The perception arouses the specific affectivity and the latter, in turn, reinforces the perception or the image. However, the specific directionality of this relationship is almost certainly determined within the cortex rather than by lower centers, such as those in the thalamus. These lower centers can only be regarded as furnishing the afferent disturbances which energize the operative lines of cortical association. When attention is directed to any particular group of things, this must be attributed, in the first instance, to the operation of some compelling external stimulus, which sets off the retroflex mechanisms conditionally or directly. The retroflex forces, in turn, reinforce the lines of association which are attached to the cortical representation of the original afferent disturbance. Thereafter, the process is one of give and take between the cortex and the thalamic centers.

Thus, when there is a simultaneous arousal of two stimulus patterns having separate and discrepant reaction consequences, the balance between these two tendencies may depend upon a competition of the reinforcing activities on the afferent side. The pattern which belongs to the most powerful retroflex system will tend to be the one which shows the highest effective stimulus intensity. This idea harmonizes with Sherrington's notion that the determinants of intensity in a conflict between reflexes or response units may be neurological and even central in locus, although quite commonly peripheral. It will be recalled that he lays particular emphasis upon affective (or pseudaffective) processes as concomitants of intensive innervations. Of course, the processes which Sherrington has considered, primarily, are localized in the spinal cord or other lower centers, but it is to be expected that similar principles will apply, perhaps in a more complicated manner, to the processes of the cerebral cortex.

196. *The Struggle Between Retroflexes*

The most disturbing forms of conflict occur, however, when the two competing response systems are each supported by powerful retroflex activities. In order that conflict should be unpleasant, at least one of these retroflexes must be negative. An even balance of positive actions may produce hesitation, indecision, and inefficiency, but not unhappiness. However, when a negative retroflex competes with a positive one, or the response creations of the latter, there is apt to be a high degree of negative affection. Sometimes, there will be an alternation of affective phases: pleasant, as the positive retroflex builds up a given response tendency; unpleasant, as the negative retroflex breaks it down again. The most important struggle of this sort in human life is that between the sexual retroflex and the inhibitory processes based upon pain, or the ego complex. The individual faces a situation in which he is impelled by sexual desire to act in a certain manner, but is prevented by "fear."

As Freud correctly points out, this is the normal condition of all individuals in society. The natural consequences of unbridled sexual gratification are such as to result eventually in pain, or its equivalent. In the case of the female, pain comes even with the loss of virginity, and intensively with child-birth. Where venereal disease is common, pain results from the infections which are almost certain to occur as a consequence of promiscuous sexual relationships. The economic burden which is imposed by unrestricted progeny, either upon the individual family or upon the state, represents an intricate nociceptive content. It sends nations like Germany to war with their neighbors. Common morality summarizes for the individual the teachings of collective experience in these matters and endeavors to restrain him in advance, by employing artificial nociceptive dissuasions. In the home, a child or adolescent may actually be punished physically for erotic transgressions. The commonest instrument, however, consists in moral suasion, in which words are used as conditioners of negative retroflex forces—fundamentally those of pain—so as to oppose the erotic tendencies.

Occidental social habits and opinions also play the ego complex against the erotic motive. A man, and more especially a woman, who unreservedly follows the dictates of erotic interest is relegated to an inferior stratum of the social order: a rake or a prostitute. An adulterer cannot retain his position in any morally fastidious organization. The mother of an illegitimate child is shunned. Thus, the ego motive tends to combat the erotic tendencies continuously. This conflict is usually more violent in the supposedly celibate state than in a happy marriage, but, for a particularly promiscuous male, may be intensified by matrimonial restrictions.

197. *The Mechanism of Repression and Dissociation*

The typical Freudian repressed complex rests upon a contest between erotically founded response tendencies and pain (either directly, or as represented by the ego complex). If we adopt this interpretation, we see that where repression occurs, the potency of the nociceptive agencies must be greater than that of sex. Otherwise, the sexual tendencies would predominate, and the fears would be repressed. Possibly this prepotency of the pain factor is characteristic only of the supersensitive individuals who come under the observation of the psychiatrist; because the normal person is more apt to pursue the sexual object, with comparative disregard of ordinarily expected consequences. Freud himself is not altogether clear as to what the agency is which brings about repression. Sometimes he calls it the Censor, and at other times the Ego; he quite commonly attributes repression to unpleasantness, although frequently the repressed unit represents a pleasure tendency. An examination of his actual cases, however, shows that the agency in question is always a negative retroflex. A study of Janet's cases,[193] in which a so-called mental trauma causes "dissociation," shows that here again we have to deal with directly or conditionally aroused negative retroflexes, especially pain.

Repression and dissociation are correctly regarded as pathological effects, although tendencies in the same direction can be observed in the majority of normal individuals. We have supposed that the normal action of a retroflex process is restricted to the connection between the afferent and efferent factors in the cortical system, although it may sometimes affect the association of proprioceptive and non-proprioceptive components on the afferent side. However, in repression and dissociation the conductance changes apparently are not restricted in this manner, but spread more generally into the afferent field of the cortex. Certain neurograms, which are singled out for repression, are cut off from the body of the afferent record system, by a breaking down of the conductances which connect them with other neurograms. These isolated neurograms may retain their association with specific retroflex mechanisms, such as that of sex, and be subject to the excitatory influences of the latter, even although they are prevented from playing any direct part in the focal synergy which controls consciousness and behavior. *Dissociation* is a more thoroughgoing effect of the same sort, in which the cortical record system is split up into a number of insulated sections, more or less comparable in magnitude or complexity.

The underlying condition for such a spreading of the negative retroflex effect may be sought in an extreme intensity of the process, which causes it to overflow its normal bounds. Such high intensity may be due to extraordinary stimulus conditions, or to hypersensitivity to nociceptive stimulation, or both. Another way of looking at the process of repression is to regard it as a normal alternative of the usual type of conductance change in extreme cases, where the usual method of eliminating a response system fails to work, on account of the high degree of habituation of the latter or, perhaps, the fact that it is constantly being restored by the action of a positive retroflex. Such a response system could be rendered inoperative by an external prohibition of its stimuli. Repression can be regarded as an internal prohibition of this sort which insulates the corresponding cortical neurogram from the afferent nerve currents, and from the cortical processes which ordinarily would arouse it associatively. This insulation may vary in degree and may sometimes be greater for association than for sensation, or *vice versa*.

If such an insulated neurogram or neurogram system were not connected with a retroflex mechanism, it would presumably remain in an inactive condition and have no consequences of any kind in consciousness. It would be like a forgotten memory. But if it is linked with a powerful affective system like that of sex, it may show a persistent activity, disturbing the equilibrium of the cortical synergy, and producing abnormal effects in consciousness or behavior. Consciousness may exhibit a marked degree of pleasantness or unpleasantness for no apparent reason. Many different varieties of this repressive condition are obviously conceivable. The repressed complex or sentiment may be cut off from certain sensory channels and not from others. It may be available to sensory excitation, but not to arousal through paths of association. Thus, an erotic neurogram might be excited by afferent nerve currents derived directly from the genital organs, but be cut off from participation in the cortical synergy, because of its insulation from all other afferent-side activities. Variations of this sort should suffice to account for the majority of the pathological phenomena which are described by Freud, Prince, and others.

Dissociation, or the "splitting of a personality," may be regarded as differing from repression, only in that the separated neurogram systems are sufficiently complicated to permit them to sustain a fairly complete mental activity within their own boundaries.[194] From the physiological standpoint, the unsplit personality is a very complex network of interconnecting neurograms, all parts of which are accessible through paths of association from any other part. In the "split personality," lines of cleavage are introduced between certain large sections of the original system. The process of dissociation—engineered by a negative retroflex—involves a selective undoing of the associative effects of previous experience. These effects involve the establishment of "cross-conductional" pathways on the afferent side of the cortex.

The phenomena which accompany dissociation will vary in accordance with the exact history and treatment of the given case. There may be an "alternation of personality"[195] which means that the cortical synergy is given over alternately to one or another of the separate neurogram systems; or there may be a division of the afferent or efferent nerve channels between the various portions of the broken-up system. In alternation, the principal focus of the afferent nerve currents and the control center for voluntary muscular innervations, represented by the synergy, must be conceived to shift from one neurogram section to another. However, the dominant personality at any moment is essentially the one which has control of the speech-motor process, and is thus enabled to give an introspective report. A simultaneous division of the afferent and efferent paths between two personality sections is observable in the phenomenon of "automatic writing," where the introspecting section has no control over the "automatic" arm and hand, and usually reports anaesthesia in these members.

198. *The Mechanism of Dreaming*

The notion of repression has been employed by Freud and others as a basis for explaining certain phenomena of everyday life,[196] including dreams, humor, and errors of perception, memory or conduct.

Dreams are supposed to constitute the symbolic or semi-symbolic fulfilment of repressed wishes, these wishes being predominantly sexual.[197] Now, in order to arrive at any satisfactory theory of dream processes, we must first have some notion as to what happens to the cortical activity during sleep. The principal function of sleep may be to permit the organism as a whole to recuperate, but it depends entirely upon a relative quiescence on the part of the cortex. The lower nervous centers are compelled to remain active, or life would cease, but the associative regions of the cerebrum are relieved of their essential duties, which consist in receiving and coördinating the afferent nerve currents and in determining thereupon the innervations of the voluntary musculature. We may suppose that the cortical synergy, as a functioning activity, disappears during sleep; there is no convergence of sensory excitations and no divergence of motor ones, to or from the cortex.

Nevertheless, the cortex may not be entirely without process. Its various neurogram contents, with their connections to retroflex systems, may continue to be excited without relying to any appreciable extent upon afferent sources of energy, and without transmitting any important influences to the muscular apparatus. It is to be expected that these units will follow their own inclinations, much as they would do in waking life if permitted to dominate a purposive thought process, or to play the rôle of desiderative images in an emotional experience. They will tend to create their own representations of satisfaction and the means thereto, although in themselves they may represent conditions which are far from being satisfactory, depending upon the exact nature and retroflex associates of the given neurogram or neurogram system. Owing to the absence of actual sensory energies, the imaginative productions cannot be contrasted with actual perceptions; and these spontaneous cortical creations may actually be more intense than when sensory energies are present to coerce the imaginative functions along certain lines. Consequently, the corresponding conscious state cannot be distinguished at the time from perceptual reality.

Now, the importance of repression and conflict for the explanation of dreams does not appear actually to be as great as Freud regards it. We should anticipate that any active cortical neurogram would tend to give rise to dreams. Those neurograms will be most irritable which have been excited most recently, say, during the preceding day, and which are subject to the strongest retroflex reinforcement. Among such neurograms are likely to be found those which represent unfulfilled desires. In accordance with what we have said above concerning the nature of emotions and related affective disturbances, an excited neurogram—corresponding to a state of unfulfilled desire (either positive or negative)—tends to remain in this excited state (perseveration) until satisfaction is attained. Although factors of this sort will be of particular importance, the motivation of dreams is not necessarily limited to their influence, since wishes which have been satisfied may also remain active. Furthermore, we may agree with McDougall [198] that the views of Freud, Jung, and others regarding the foundations for the specific symbolism of dreams are quite fantastic, and that the symbolic tendency is merely a consequence of the primitive character of the dream thought process.

199. *Humor and "Lapses"*

The Freudian explanation of wit and humor, or the "funny," is much more satisfactory than the Freudian theory of dreams. It seems to be a universal principle that the perceptions or ideas, giving rise to laughter in the adult, are associated with some interest in conflict with the one which dominates the given situation. Such interests are not necessarily repressed in the sense that their representation is generally cut off from consciousness. They are ideas having positive retroflex associates but subject to negative retroflex action under the given circumstances, ordinarily those of conventional social intercourse. Usually, the negative action has operated to eradicate the supposedly natural behavior reactions to these ideas, at least under the specified circumstances. Among such ideas are included those of sexual anatomy and relations, misfortunes of one's fellow men, the excretory functions, liquor (in the United States), etc.

The *"double entendre"* of a joke has the effect of arousing the discountenanced idea, with its accompanying pleasure tendency, without exciting the nociceptive or unpleasure tendency in a proportional degree. If it were not for the technique of the joke, the negative force would continue to dominate the positive one, but the peculiar combination of associative relationships which characterizes the witticism temporarily turns the tables. Since there is usually nothing to be done "about" a joke, and the traditional motor expressions are powerfully inhibited, the cortical excitement relieves itself by discharging into the breathing center, which is one of the most accessible of motor outlets, a reaction that is not liable to be inhibited because it has no objectionable consequences. The pleasurableness of the joke is due to the conditioned arousal of a positive retroflex, such as the erotic or those which are particularly attached to the superiority phase of the ego complex.

The Freudian explanations [200] of lapses of memory, perception and behavior may be taken over without essential modification. Failure to perceive a thing which is before one's eyes, or to remember a particular fact, may frequently be attributable to repression of the corresponding neurogram. It is by no means a general truth, however, that we tend to perceive or to remember everything possible, and the principle of repression is only required when there seems to be a positive reason why the given thing should be perceived or recalled, as well as a more powerful reason why it should not be. Apparently involuntary behavior which works toward the fulfilment of a repressed wish is readily explained on the assumption that the motor connections of the dissociated neurogram still exist, although its afferent linkages are severed, at least in the given situation. The dropping out of a component of behavior, when the corresponding perceptions are clear in consciousness, may be due to the converse condition; which does not involve repression but only normal inhibition.

200. *Can Retroflex Conditioning Be Altered?*

A question which is of prime importance is whether connections which have once been established between given afferent processes (or neurograms) and retroflexes can later be broken. Can the conditioning of a retroflex process be abolished? The actual facts of experience indicate that conditioning associations are relatively permanent, but that in some cases they are apparently undone. Such associations presumably operate between the cortex and the thalamus, rather than between different portions of the cortex, so that the principles which are involved may well be different from those which hold for the cortex alone. The psychoanalysts claim that they can cure the disorders, which result from repression or dissociation, by reëstablishing the broken associative chains and restoring the integration of the personality. Insofar as the symptoms depend upon the dissociation—over and above the sentiments and complexes, merely as such—this method would seem to be practicable. But it is a different matter to destroy the unrepressed sentiments or complexes. Knowing why one is afraid of a bear does not necessarily remove the fear.

However, it will be noted that reasoning and other processes can establish a condition in which we no longer fear the bear. We may not fear the animal, for example, if we carry a gun, or if he is fastened to a post with a strong chain. Someone may assure us that this particular bear is very tame and harmless. Do these processes destroy the original conditioning? Probably not. It is more likely that they are to be correctly interpreted as changing the form of the afferent activity in the cortex, so that the neurogram which conditions the pain retroflex is no longer involved. The perception of a bear securely fastened is distinct from that of such an animal at large. The perception of ourselves facing a wild beast with a trusty firearm is quite different from that which accompanies the absence of a reliable weapon. Even the process of being persuaded that the special animal before us is quite tame probably involves the same kind of a change; it only saves us from fear of this particular bear when we are able to recognize him clearly as an individual. It is likely that the psychoanalytic method of "abreaction" is actually of this sort; resting upon the construction of a new neurogram—without disturbing retroflex connections—with which the patient can perceive the stimulus that otherwise would arouse the old neurogram and an undesirable emotional reaction. Instead of the associative system becoming simplified, it is increased in intricacy.

Apparent loss of conditioning is more evident in the erotic sphere than in other affective departments. It is not uncommon for erotic sensibility to a particular person to lapse as suddenly and completely as it was generated. The state of being in love is characterized in most instances by restriction to a single person in any one period of time. We refer here not to habits of love service, but to the highly pleasant emotionality of the love experience. However, this rule is not without exceptions. There are undoubtedly a number of distinct processes by which specific erotic sensibility can wane. When the waning is slow, but not final, it may be assumed to depend upon loss of novelty, the intensity of the original pleasure being a resultant of the principles of eroticism and exercise. Where the change is more sudden and complete, there is usually a perceptual transformation, sometimes called "disillusionment." The lover may learn that his sweetheart is untrue to him, or that in some other way she (or he) is different from his previous conception. In this case the original conditioning neurogram is no longer excited, and a new one—corresponding to the revised idea of the formerly loved person—takes its place, sometimes with nociceptive associates.

Chapter XXV

Some Common Motivational Processes

The principles which have been expounded in preceding chapters should be capable of explaining any motivational process. However, the exact pattern of application of these principles will vary widely with particular circumstances and the forms of the cortical systems which are involved. It is impossible to consider all typical forms of this sort, but it may be instructive to deal with some additional concrete problems to illustrate further the mode of application of the principles in question. These are presented as examples of motivational analysis.

201. *Three Motivational Analyses*

Consider the case of a five-year old child, who cries and struggles every time she is placed in a barber's chair to have her hair cut. This is an example of conditioned pain retroflex action, due to the fact that on her first visit to the barber's the latter pulled her hair severely in the process of cutting it. Now she associates the perception of her position in the chair, and the barber before her, with this pain process. She experiences no pain, as such, but is subject to an intense unpleasantness, and exhibits the unrest and reflex disturbances which are characteristic of so-called fear. She may be said to be afraid of the barber, or of the barber's chair, although this means merely that these perceptions arouse her pain retroflex, conditionally. Later in life she may have a particular aversion to barbers' shops in general, and will probably wear her hair long in spite of a prevalence of the bobbed-hair mode.

Consider, next, the case of a "flapper," who has seen a dress in a store, and has regarded it as especially suited to her style and complexion. The image of the dress floats constantly before her mind. She imagines herself wearing it at the coming fraternity dance, while she is dancing with "Jack," other girls appearing relatively dowdy in comparison with her. Her consciousness is agitated with representations of possible means whereby she may get the dress. She has no charge account in the store, but calls upon a friend who does have one and obtains permission to purchase the dress on the friend's account; and then stints herself for weeks on lunches to pay the debt. The underlying force in this process is essentially erotic: the flapper's sex tendencies are conditioned, firstly, upon men in general; secondly, upon "Jack," and thirdly, upon the means by which his attentions may be won. These means include attractive costume and make-up as prime essentials. The average feminine ego complex is largely built upon an erotic basis; inferiority and superiority are mainly conceived in terms of the supposed degree of attractiveness to the male sex. These erotic forces are much more powerful than those of moderate hunger or the pleasures of good food.

A young man who has borrowed money in order to study art desires to repay his creditors. He feels himself to be in an inferior position economically because of the indebtedness, and this thought is naturally disagreeable to him. However, instead of spending all of his time in the quest of opportunities to earn money by practising his art, he wastes most of it in association with other persons who are also in an inferior economic position, and expends a great deal of energy advising them as to how they may best solve their problems. The motivating force in this case is the inferiority phase of the ego complex. The given individual has had no adequate training in practical affairs or in the "school of hard knocks," and is still able to rely upon other people for support. The inferiority perception therefore fails to arouse any very useful instrumental images, and the ego complex operates to avoid the inferiority perceptions by placing the person in a situation where he perceives himself to be relatively superior to the other people with whom he voluntarily associates. By advising these people with regard to their welfare, a perception of superiority is developed which brings relief. Since there is no actual pressure of economic necessity, this process can continue without inhibition and the man is judged to be of a sympathetic nature, which leads him to consider the welfare of his fellows in advance of his own.

202. *The Motivation of "Argument"*

One of the most amusing forms of misplaced motivation is that which frequently operates in the case of two persons who are having "an argument." The purpose of such an argument is usually twofold. In the first place each individual is trying to prove that he, alone, is "right." Secondly, he may be trying to persuade the other individual to modify his conduct in a definite way, which will be of advantage to the would-be persuader. The concept of "being right" is susceptible of various interpretations. Usually "being right" implies: expounding the truth, but, as a rule, the arguing individuals would be quite unable to define what they mean by truth. This is particularly the case in so-called moral argument. Consider for example a couple of Indian Buddhists in a debate concerning the most appropriate method of conciliating the spirit of the Ganges; or a trade-unionist wrangling with a representative of capital regarding the "natural rights" of the laboring man. Truth, in such cases, can only be defined in terms of the logical consequences of certain arbitrary postulates which the arguing parties are quite incapable of formulating of utilizing logically even if these postulates were definitely before their minds.

The psychology of such argumentation—represented in classical form in the academic debate—consists, primarily, in endeavoring to "kid oneself" into a feeling of superiority, the essential motivating factor being the ego complex. The instruments are essentially verbal, although there may be accompanying images of a non-verbal character, which sometimes give meaning to the words. The first step in an argument is naturally for the two persons who are involved in it to take opposite sides. Their choices in this matter will usually be determined by their previous experiences, in which they have associated the propositions which they respectively advocate with some of their positive retroflexes, or those which they denounce with their negative retroflexes. The differences between the biographies of the two individuals in the argument will suffice to explain the fact that their associations are not the same. Thus, if one of the men is the son of a capitalist, he will have received pleasure and have avoided pain because of the existence of the capitalistic system; whereas if the other man is a laborer, he will have suffered hunger and pain and have been deprived of certain pleasures of life in association with the capitalistic order. In other cases, however, the choice of sides in an argument may be quite arbitrary, as in a school debating society; but once the individual has advocated a certain view, he feels it necessary for the maintenance of his superiority to remain consistent. Occasionally, we discover a very sophisticated person who regards consistency as a token of intellectual inferiority, and who, therefore, delights in changing his mind as frequently as possible.

The process of argument of course consists in the verbal support of one's own thesis and the demolition of that of the opponent. From the standpoint of pure logic, this process should comprise the demonstration of facts which imply one's own view and which are inconsistent with that of one's opponent. However, from the psychological standpoint, the process consists in formulating verbally any ideas which may arise by association, as instrumental images, with the argumentative purpose. In the crudest forms of argument, this process amounts to little more than a vociferous series of affirmations or denials of the points which are primarily at issue. Where possible, the opponent is made out to be a fool, a rogue, or to belong to some other class of inferior persons.

203. *Suggestion and Hypnosis.*

The use of argument as a method of persuasion, i.e., of inducing a desired form of behavior in another person, presents some very interesting motivational problems. Titchener has said that action follows from "suggestion"; in other words, that ideally we have only to describe a given form of behavior to a man in order that he should proceed at once to act in the indicated manner. It is evident, however, that when it really works, this principle of suggestibility must have a rather complex basis. Suggestibility seems to exist in the most extreme and purest form in the *hypnotic state.* The phenomena of this state seem to be consistent with a very simple motivational formula, to wit, that the words of the hypnotic operator arouse corresponding kinaesthetic images which are attended to immediately, with resulting and corresponding action. It also appears that the operator's verbal commands can control the contents and effectiveness of sensory fields in addition to the auditory field. The ordinary system of responses seems to be in abeyance, as in sleep; it is as if the habits and complexes of the individual had been temporarily set aside so that none of the neurograms belonging to them are accessible to sensory stimulation. However, the subject's idea of the hypnotic operator evidently plays a very important part in determining the responses of the former.

Now, such a tendency, to follow without dispute the commands of a particular person, can be demonstrated in other circumstances not involving hypnosis. This is the normal attitude of an employee to his employer, of a soldier to his superior officer, of a child to his parents, of a citizen to the state, or even of some husbands to their wives. However, in these cases it is complicated subjectively by a certain amount of obvious conflict, since obedience is not always spontaneous, and may follow only after some hesitation and struggle between opposed ideas. There is also no control over the sensory fields in general. The hypnotic state is, therefore, signalized by a condition similar to repression or dissociation, but which is probably even more closely allied to ordinary sleep. Nevertheless, in other respects, the motivational basis for the obedience, which the subject shows to the hypnotic operator, may be quite similar to that which underlies obedience in the other cases.

This basis is certainly not one of pure suggestibility. It consists in the fact that the person and voice of the one who is obeyed has become a powerful conditioner of retroflex forces. We have already seen how the obedience of an employee to his employer can operate through the instrumentation of the ego complex, with its associated retroflexes, to force the responses of the employee along the lines commanded by the employer. In the case of the child in relation to his parents, physical pain may follow from disobedience, as in corporeal punishment. It appears from McDougall's discussion [201] that the two most successful methods of establishing "rapport" between the operator and the subject in the hypnotic relationship are either to domineer and browbeat the latter, or to secure his coöperation on the basis that he will benefit thereby. In the one case, submission is a consequence of fear and, in the other, of hope. The state of semi-sleep which is induced by bodily relaxation, and other devices, renders the process psychologically less complex than that which accompanies obedience in the ordinary waking state. The failure of hypnotic commands to be followed when they conflict in any important manner with the subject's actual welfare is evidence that his ordinary motivational tendencies are not entirely set aside. The situation here is the same as that which would develop if an employer commanded his servant to do something which was seriously prejudicial to his welfare.

Probably the highest degree of suggestibility is developed in situations where a man is threatened with death or intense pain if he fails to obey. He may be held up by a gunman and told that if he does not follow instructions he will suffer a supreme penalty. In such cases it would be a rarity for the individual not to obey. The situation is evidently such as to make the idea of disobedience a powerful conditioner of the entire system of negative retroflexes and that of obedience a conditioner of the whole group of positive ones. The stimulus (situation) is unique and, hence, calls forth no well-established response. All alternatives other than those which are indicated by the words of the "operator" are immediately inhibited, because they constitute forms of disobedience. If, however, compliance with the commands lead the subject into a situation for which he has well-developed responses, the inhibitory effect may prove to be inadequate. Thus, if the gunman should order his victim to murder a friend, he would, undoubtedly, be disobeyed. The same recalcitrancy would be encountered by the hypnotist in connection with a similar command. Also, it is not uncommon for a man to maintain his customary habits even when he has been told by his physician that doing so will mean loss of health, and even death. We have here to deal with a quantitative struggle between different opposed motives.

204. *The Basis of "Belief"*

One of the most important features in such situations is expressed by the word, "belief." If the victim of a hold-up does not *believe* that the gunman will shoot, or that the revolver is loaded, he will not be constrained to obey the commands. William James has suggested that belief consists simply in a disposition to carry out a proposition in action. Similarly, we might define belief, in terms of our theory, as the simple fact that the statements made by the gunman or the physician actually do condition the retroflex processes. A man believes that a bear is dangerous when the bear really becomes an object of fear, or he believes that woman is the proper satisfier of the sexual impulse when she actually arouses this impulse in him. It is still necessary, however, to specify the circumstances for the production of belief in this sense. These circumstances are evidently of various sorts. The individual may be predisposed on account of his previous experiences to be easily conditioned by certain stimuli and not by others. The exact character of the stimuli in relation to these predispositions is also of great importance. A gunman may induce belief by using a harsh tone of voice, or by inflicting actual pain upon his victim, showing that he "means business"; whereas if he is weak and cowering in manner, his words will be unconvincing.

205. *Bases of Persuasion*

To return to the mechanism of persuasion by argument, we may assume a situation in which neither individual has any special power over the other's retroflex processes; they do not stand in the relation of employee to employer or the like. The exact course of the process will depend upon the particular attitude which the individuals naturally adopt. If the argument is between two scientific men or engineers, whose actual welfare lies in the discovery or utilization of objective truth, persuasion will depend largely upon adducing real evidence, and an application of approved principles of logical reasoning. Facts and logic in this case are conditioners of the ego, or other operative complexes. At a slightly lower level of intellectuality, the recognition of facts and logic coerces the individual by making him perceive himself to be a fool, when arguing or acting in opposition to the consequences of these processes. However, a commoner method of persuasion is to call up, or to create, associations which explicitly link the desired form of response with positive retroflexes, or the one which it is desired to prevent, with negative retroflexes. Thus, in "moral" persuasion, it may be asserted and "proved" that the desired reaction is "good" or the discountenanced one "bad." "Mr. and Mrs." in the Briggs comic strip persuade one another by various methods of emphasizing the inferiority of the other.

206. *Moral Suasion*

Many supposedly profound studies have been directed toward the explication of ethical terms, such as "right," "wrong," "good," "bad," "duty," etc. We shall consider some of these investigations critically in a later chapter, adopting, as nearly as possible, the "ethical" point of view. Although the problem is rather difficult to solve when these terms are regarded as designations of fact, there is no difficulty in interpreting them from the psychological standpoint as practical instruments of social control. They are the voice of society, speaking imperatively to the individual, and telling him that certain forms of behavior will be punished and others rewarded. If, however, the morality terms are to be operative upon the individual they must condition his retroflex processes, and if they are to act in this latter manner they must have been experienced in conjunction with these processes, preferably at an early age. This occurs in a well-engineered "bringing up" when a child is punished physically while he is being told that he has "done wrong," and is rewarded with sweetmeats or other desirable things, while he is informed that his behavior is "right." This is the proper way to "rear a child," if his reactions to the moral voice of society are to be effective in later life. At a more advanced age, the morality terms can operate through the mechanism of the ego complex, if it is made clear to the individual that he who does his duty and the right is superior; whereas he who fails in his duty and commits evil is the lowest of creatures. Religious teaching aims to reinforce the retroflex associates of morality terms not only by doctrines of this ego type, but by promises of eternal happiness, or threats of eternal damnation.

207. *Motives in War*

The voice of the *nation* also speaks to the individual, particularly in the state of war, where the tumult of human motives reaches maximal violence. It uses the terminology of patriotism. War is motivated by all of the retroflex agencies, but particularly by hunger. The relatively uncontrolled operation of sexual desire increases the population of a country like Germany beyond the possibility of supporting its progeny upon the fertility of its own territory; hence, its people must starve, trade or fight for more territory. When neighbor nations refuse to trade on profitable terms, the only alternative is war. But the declaration of war is not made by those who are likely to starve; rather, it is the act of kings, statesmen or politicians, whose motives are those of the ego complex. However, the people are also victims of a specialized ego system in which their own country is compared with other nations and which gives rise to patriotic feeling. When their country seems to lack a "place in the sun," they experience a strong conviction of inferiority which inhibits their ordinary activity, and makes them especially susceptible to the arguments of the Junkers. In a militaristic nation, to be a soldier is to be superior and, particularly, to be admired by women; but in democracies like the United States, the majority of men who go to war do so because their country has threatened to penalize them if they evade the draft, or because a "slacker" is regarded as a most inferior being.

The state of war develops its own characteristic verbal conditioners for the two contrasted aspects of the normal ego complex; but within the mind of the soldier at the front there is fear and conflict. On the battle line, the primary retroflexes of pain, or their most direct conditioned arousals, become the dominating factors; repression and dissociation may ensue; and, if the soldier lives to return, his patriotic complex is thoroughly overwhelmed. The voluntary choice of a soldier's life in active service is an outstanding example of the possible utter inadequacy of operative motives to represent the affective consequences which may result from their action. A man may choose to become a soldier because of the persuasive eloquence of a recruiting officer, or because his friends call him a coward; but by signing his name to a piece of paper he places himself in a social situation where nociceptive processes will operate continuously upon him, to prevent him from doing anything which can save him from misery and death.

The relationships between parents and their offspring furnish an interesting field for motivational studies. A son may be a "chip of the old block," and differ very little from his father in fundamental motivational make-up; yet the two are almost certain to develop conflicts with each other. The son falls in love with a pretty girl of low social standing, neglects his duties about the home, and expresses his intention of marrying. His motivation is purely erotic. The father may be equally erotic in disposition, but the behavior of his son constitutes an inferiority stimulus to his ego complex, and may even bring physical discomfort, when he has to perform the chores which the son has neglected. He therefore reprimands the latter and threatens him with bodily punishment or withdrawal of economic support. Thus, to the son, the father also becomes a conditioning nociceptive stimulus and a person to be disliked and avoided. A struggle ensues between the son's erotic interests and the inhibitory agencies, as a consequence of which one or the other will conquer according to their relative potencies.

208. *The Mechanisms of Worry and Sorrow*

Two of the most intensely unpleasant experiences to which the human mind is subject are those called *worry* and *sorrow,* respectively. *Worry* is an experience of the emotional type, in which consciousness is dominated by an unfulfilled or defeated purpose, and is seeking means of fulfilment or restoration. The ideas of such means which arise, one after another, prove to be inadequate, so that the purpose makes no progress towards satisfaction. This inadequacy of the "instrumental images" may be attributable to low imaginative ability or lack of experience, to an impractical tendency of mind, or to the real difficulty of the situation. Frequently, the stimulus to worry is not an obvious objective condition, but is merely a state of affairs which is alleged or believed in. Thus a man may be prosperous in business at the present time, but may worry about the future. He may be perfectly well, but believe that he has a fatal disease. In such cases the struggle involves a perseverative idea with nociceptive associates, from which relief can be gained only by a demonstration of its unreality in actual perception, or, perhaps, as a consequence of the passage of time. Worry is usually due to disturbances of the ego complex, which are typified in extreme form by the persecutory delusions of paranoia.[202] We have presented several examples of worry of this sort in our discussion of ego complex.

Sorrow is an affective state, resulting from the removal of an accustomed stimulus which strongly conditions one or more positive retroflex mechanisms. It may also accompany the loss of a stimulus which stands for protection against nociceptive excitation. The most typical form of sorrow is that which follows the death of a loved person, such as a wife, husband, or mother. About such a person, a vast and powerful system of responses has been built up through the action of the positive retroflexes which this person conditions. The death of the loved object directs attention to the idea of this object, but the responses can no longer occur. They must therefore be inhibited; their conductances must be depressed progressively until they are destroyed or the stimulating ideas disappear. Hence, the strong negative affectivity. Every specific memory or occasion for behaving in some familiar characteristic manner with respect to the departed person brings a new twinge of anguish, as the corresponding responses are laid aside forever. A very similar mental process appears in connection with the loss of some cherished material object such as one's automobile, by theft, or one's home by fire.

The outstanding problem in connection with this explanation appears to be as to the identity of the agency which operates to eliminate the useless response systems. Possibly, we shall be obliged to assume that there is an hereditary mechanism which is especially entrusted with this function. However, some other possibilities readily appear. The inferiority phase of the ego complex may play a part; a man who continued to react to a corpse or a demolished home as if nothing had happened would be adjudged a fool and a lunatic, and the pursuit of such response tendencies would most likely lead to primary nociceptive excitations. The ideas of death and of dead bodies are associated very powerfully in the ordinary mind with the pain retroflex, and arouse strong fear reactions. The enforced identification of these concepts with that of a loved person generates a violent mental conflict, in which, from the nature of the case, the positive tendencies cannot win if the individual is to retain his sanity. The only alternative to inhibition is withdrawal from reality into a life of hallucination.

209. *Forms of Suicide*

Sometimes men voluntarily make corpses of themselves. Why? It is not necessary to assume that the suicide has examined all of the affective values of his possible future, and has coolly calculated that they will summate to a negative quantity. It is more likely that he is faced by a nociceptive situation in which the suicide impulse is the only one which offers any possibility of immediate relief. Frequently, suicides have contemplated the act with interest for a long time, and may even have associated it with positive retroflex tendencies. This is true among some Japanese, for whom the idea of *hari kari* is linked with that of superiority, particularly in the hereafter. McDougall [203] points out correctly that fear is not fundamentally an aversion to death. From our standpoint, it is fundamentally an aversion to pain, and it is well-known that suicides ordinarily pick a supposedly painless method of passing from this mundane world.

There are other and more glorious ways of ending one's earthly career. One of the most popular among modern adventurers appears to be that of "hopping" off over the ocean in an aeroplane. The motive of winning prize money is probably subsidiary in these cases to the representation of a tremendous ego superiority which may come to those who are successful in such attempts. Never in the history of the world, perhaps, has there been another case of such meteoritic rise to sublime superiority as that of Lindbergh, and probably also, be it said, never a person who could receive such a stimulus with less show of vanity. But if Lindbergh's ego was not strongly reached by the plaudits of the world, it undoubtedly was by the actual fact of his perfect success in applying the art of aerial navigation, for which he had planned industriously, and with engineering skill. At any rate, he has quite evidently formed a persistent habit of making long distance international flights.

But what is the motivation of the tremendous popular enthusiasm concerning feats such as those of Lindbergh or Byrd? It is probable that we have to deal here with a form of sympathetic egotism, in which the act of the hero exalts our own species, race or nation and hence ourselves. There are other minor factors, no doubt, such as the excuse for a celebration, with its relief from humdrum everyday activities.

210. *The Action of Narcotics*

Then, there is *liquor,* which is apt to flow freely during celebrations, even in the United States. Now, we are constrained to believe that the formation of alcoholic and other drug habits does not depend primarily upon the operation of retroflex processes; for these mechanisms have no necessary monopoly of the operations whereby conductances are altered. If we could reach into the cortex with a physicochemical instrument which would change the nerve structures in the same manner in which they are affected by the retroflex process, the result would be the same, both for response and for consciousness. In effect, this is what is done by narcotics which are taken into the blood stream. They act like artificial retroflex devices, raising cortical conductances and giving pleasure because of their chemical action upon the nervous structures. Thus, they establish habits of taking the drugs and of doing the things which are necessary to procure them. It is possible, furthermore, that some drugs may either excite or inhibit the subcortical retroflex control centers. Excessive use of narcotics, particularly of drugs like morphine and cocaine, may be supposed to increase conductances to such an abnormal degree that in the absence of the drug, they decay again with extreme rapidity producing highly unpleasant states, which can only be alleviated by further doses.

Chapter XXVI

Some Modern Interests

We may continue our application of motivational analysis in a study of some characteristic modern interests, although not all of them are really new.

211. *Motives in Business*

Probably the most powerful of such interests is that in *business*. Business is obviously a means of making money, which is a means for satisfying practically all of the retroflex tendencies, of gaining any pleasure or avoiding any pain which it is possible to avoid. "Business before pleasure," is a saying which may be interpreted as expressing the relationship of a means to an end. But to many men, particularly in the class of entrepreneurs, business success becomes an apparently self-sufficient motive, a conditioner of retroflex processes in the absence of any consciousness of the intermediate phases of its relationship to fundamental motivational forces. About the idea of such success there is built up a powerful system of habits, which may continue to operate in characteristic manner even when conditions develop under which they are no longer required to minister to the economic welfare of the individual.

The most enthusiastic and successful entrepreneurs are frequently those who already have so much money that there is nothing further for them to gain economically. They continue, however, to enjoy "playing the game." For such a man, business success and failure have become direct conditioners of the ego complex. The list of his financial accomplishments, or of his investments is a measure of his superiority to other men. Moreover, the concept of his own status in society becomes identified with that of the business enterprise which he represents, and the actual or threatened failure of this enterprise constitutes a powerful nociceptive stimulus, operating to divert the business man's attention from all other lines of endeavor and compelling him to labor to restore its financial condition. For such a man "resting is rusting." Take his business activity away from him and his life becomes one of sorrow and boredom. Since in the majority of instances the intensive business man has failed to develop other effective conditioners of his positive retroflexes, and being rather too advanced in life to form such associations readily, he no longer finds the world to be interesting.

212. *Motives in Politics and Religion*

Politics *presents* a somewhat similar field, but one which is more exclusively a domain for the ego complex, simple and unadorned. In a democracy, the election of a man to public office by popular vote, is an expression of a judgment of superiority, made by a large number of his fellow-citizens. No stimulus to the superiority phase of the ego complex could possibly be more effective than this. In politics, we find an hierarchy of offices, so that until the office-holder becomes President or Prime Minister, it is always possible for him to feel inferior, as well as superior, and to struggle for further advancement. The operation of the ego complex furnishes the real explanation as to why men work to secure political preferment, even when it fails to bring any economic advantage. Sometimes, of course, the politician has additional motives, economic in the case of the "grafter," or theoretical as in the case of the reformer. He may have been a believer in single tax or free trade before he became a politician. However, as a rule, he is compelled to invent his platform, as a necessary instrument to the fulfillment of his egotistic ambition. But when he has once identified himself with a particular political party or issue, these things become stimuli to his ego complex, and their fortunes throughout the country or the world affect his own happiness in a forcible manner. He praises his own group, regardless of their personal qualifications, and denounces his opponents systematically, on general egotistical principles, by any means which may come associatively to his mind.

Modern *religion* appeals to many fundamental motives. Among other aspects, the Church presents itself as a political organization, within which a person may demonstrate his superiority over others by becoming superintendent of the Sunday School, a committee member or chairman, or the like. Similar opportunities appear in lodges and fraternities. If the man is a preacher, or a priest, he can advance along the ecclesiastical hierarchy. The Church provides a meeting place where women, in particular, can learn the affairs of other people and utilize their knowledge to compare these other parties unfavorably with themselves, in the familiar amusement of "gossiping." In these and other ways, the Church furnishes stimuli for the ego complex.

The function of religion in modern occidental society is manifold. Insofar as its teachings follow the principles of Christian philosophy, they are directed against rather than in line with the tendencies of the ego, and are intended to inculcate altruistic forms of behavior, by verbally associating the ideas of such behavior with positive retroflex mechanisms, including those of the ego complex itself. The origin of such teachings in the sayings of Christ must be understood in terms of his own individual psychology and environment; but the persistence of the Christian philosophy is to be attributed to the fact that it has actually strengthened the nations which have been subject to its influence. The discouragement of undue egotistic conduct solidifies social efforts. Christianity is to be contrasted in this respect with Oriental religions, such as Buddhism, which have deified ideas and customs which are biologically meaningless, or actually detrimental to social and individual progress.

The doctrines of Christianity also gain a hold upon the minds of men because they salve many unpleasant inferiority feelings, by glorifying the weak and unfortunate and spurning worldly success. In their more practical versions, such as Christian Science, they operate to repress pain, resolve conflicts, and increase the happiness of the susceptible individual by a powerful process of suggestion. When such results are produced, the benefiting person acquires a Church-going habit in accordance with the principles of the motivational theory which has been expounded in the present book. To be in Church along with fellow-believers, is to escape from real or imaginary pain, and to gain positive retroflex stimuli. In the latter connection, we must not forget that the Church furnishes the scene of many romances, and puts the final seal of approval on sexual relationships between man and wife. Thus, whatever there may be that is supernatural in modern religion, there is an abundance of the natural.

213. *The Motives Behind Scientific Effort*

The career of the *academic* teacher or scientist is largely motivated by the ego complex. In the field of learning, there is a vast and continuous hierarchy of appointments and possibilities of intellectual achievement, within which the individual can progress. Each advancement or expansion of his scholarly reputation stimulates the superiority phase of his ego complex, and failure to advance irritates the inferiority component. Usually, the accompanying economic rewards are inadequate to account for the energy which academic people display in writing and research. In comparison with the demands which are made upon the business man, their life can proceed at very low tension.

There is a point in modern life, however, where academic science joins hands with the requirements of business. This occurs in technology or engineering. In the research laboratories of industrial America, we find men who are endeavoring to wrest the truth from nature's hiding places in the interests, primarily, of "economic progress": the financial benefit of the men who are gambling on the scientist's efforts and, only incidentally, the happiness of humanity in general. And what is their motivation? To a large degree it is still that of the ego complex, but not so much as to standing in the eyes of the public as with respect to dominance over the practical difficulties which they face; and to a more important degree the fear of failure in the task which they have been set to accomplish.

But is there no unadulterated love of scientific truth? The answer must depend, of course, upon what we consider to be an adulterant. A searching study of the motivational processes which have controlled the lives of great thinkers would probably reveal a distressing amount of seeming adulteration. Many profound truths have been demonstrated because of the desire to make one's opponent appear as a fool, or in compensation for inferiority feelings. Academic or industrial ambition will account for many more. Yet there may be some dilettantes who dabble in scientific research merely to secure novel experiences or to satisfy a random "curiosity." However, we may well doubt whether the products of these men are usually included among those which have the greatest human utility. The universe is full of innumerable details, which can be searched out, and they are all on the same level so far as unguided curiosity is concerned. Only when the problem is selected with some reference to human wants does its solution have a good chance of possessing substantial value. Men who try to create new knowledge, or material products which will bring them rewards and recognition from their fellows, are liable to be the greatest contributors to human welfare, as well as to their own self-interests.

Thus, modern applied science provides us with the instruments for more pleasure and less discomfort: automobiles, oil-burning heaters, electric refrigerators, telephones, radio, motion pictures, and myriads of other useful and amusing things. The acquisition and ownership of these things furnish new stimuli for every man's ego complex, as well for his eyes, ears and stomach.

214. *The Automobile*

In American life, the automobile is a very important motivational agency, being preferred by many individuals to good food or shelter. The popularity of the motor car depends upon a rather large group of factors. Primarily, automotive transportation relieves us from the nociceptive processes of muscular fatigue which accompany walking, or even waiting for less efficient means of travel. By decreasing the time during which we are forced to inhibit the impulses that dominate our behavior as we move from one point in space to another, it contributes to the prompt satisfaction of innumerable positive tendencies and the relief from negative ones. There is protection from cold in winter and from heat in summer. Then, there is the joy of "going for a ride," which rests upon the principle of novelty, as the automobile presents a rapid sequence of different scenes to the eye. The motor car is also a very convenient accessory to sexual courtship.

However, the relation of the automobile to the ego complex is very intimate. The owner of a car perceives himself to be superior to the pedestrian; and if his car is a powerful and handsome one, he experiences a profoundly pleasant contempt for the owners of cheaper models, and imagines that all eyes are on him enviously as he whizzes by. The man who does not own one is depressed correspondingly. The ego complex is stimulated further by the effortless control of a powerful mechanism, which leads some drivers to irrational speeding and racing. The normal exaltation of the ego which accompanies a position at the wheel of a motor car overcomes many of the ordinary inhibitions of social intercourse, resulting in a uniform discourtesy in the reactions of automobilists to each other or to pedestrians. The average driver regards all of his fellow-beings outside of the car as on the same level as dogs, who may get in his way on his all-important trip to town to see the latest musical comedy.

215. *Motives Underlying Aesthetic Enjoyment*

Newspapers and magazines appeal to a wide variety of motives. The stimuli are always verbal, but they are translated through association into images of other sorts. A person picks out of a newspaper the ideas which "interest" him. He enjoys most of all reading about himself and the enterprises with which he is associated, because he thinks that it lends distinction to his personality to be mentioned in the paper. But he can also follow sports, the stock market, political affairs, etc. The greatest appeal, however, of the newspaper and magazine appears to be that of the "story," whether the stories are fictitious or are based upon happenings in real life. What is the underlying motive which leads people to read, with such avidity, the accounts of criminal behavior which occupy so much space in our newspapers and other periodicals? The acts which are described are frequently such as would normally be terrifying and highly unpleasant to witness in actual life. Yet they are rather more appealing when regarded as descriptions of fact than when conceived as fiction.

This same problem presents itself again in connection with certain kinds of novels, motion pictures and dramas. In the case of a novel, there is perhaps less conviction of reality, or arousal of belief, since we are prone to regard newspaper accounts as representing actual facts. However, the literary skill of a great novelist may compensate to some extent for our awareness that, after all, the story is quite imaginative. In the case of the motion picture, owing to the substantial elimination of words and their substitution by the kinetic visual presentation of the story, the reality impression is further enhanced. The greatest degree of realism is achieved in a well-acted stage production, where color, perspective and sound combine to create an impression which is very close to that of normal life. The perceptions, however, are still framed in a proscenium arch, as in the movies they are fixed upon a screen, and in the novel are suggested by the printed page. The attitude of the reader or spectator is radically different from that which he would adopt if the events were those of real life, and in which he was personally concerned. Although emotional reactions are aroused, they do not go over into the same kind of behavior which would follow from similar stimuli outside of the frame of the stage, screen or book. This attitude has sometimes been identified with that of aesthetic appreciation in general; objects of art being conceived as representations which would normally excite intensive emotional response, if the situation did not contain additional factors which inhibit such response.

Now the appeal of dramatic or literary representations certainly has a complicated foundation. The principle of novelty is of the utmost importance in attempting to account for the pleasure which such representations arouse. There are very few novels which will bear a second reading, no matter how fascinating they may have been upon their first perusal. The same proposition applies, with even greater force, to plays and motion pictures. The predominant source of the pleasure thus appears to lie in the formation of new associations, as the plot develops. However, in order that such associations should be intensive, and should firmly displace other cortical tendencies, it is necessary that the factors which are involved should have particular "interest." Such interest is assured if the things or ideas which are presented are conditioners of either positive or negative retroflex mechanisms, since in this case there will be a reinforcement of the afferent excitations in accordance with the principles which we have previously discussed.

If the retroflexes in question are positive, there will obviously be a reason, in addition to that of mere novelty, why the accompanying consciousness should be pleasant. When the novel or the drama presents an erotic or romantic incident, the associative arousal of the sexual retroflex makes a very important contribution to the pleasantness of the resulting consciousness. Romance is undoubtedly the most important single component of any successful dramatic or literary presentation. The revue or musical show, or the screen comedy, make very direct appeals to masculine eroticism by their open delineation of feminine pulchritude. However, the erotic appeal of such presentations is evidently different in its effect, and less intense than that which attaches to the same object, or situation, in real life. The degree of nudity which is permitted upon the stage is always in excess of that which would be tolerated upon the street. Knee-length skirts were a commonplace in musical comedies when they were still a sensation on the avenue; and when they became a familiar sight in the latter environment, the New York theatrical producers felt themselves licensed to exhibit the female form in almost complete nudity.

When the stage, screen or novel represent objects or situations which arouse negative retroflex processes, they still succeed in bringing about the reinforcement of afferent cortical activities—corresponding to perception and association—which is characteristic of retroflex excitation in general. At the same time, the essential retroflex action will be aroused with the relative feebleness which we have considered above in connection with the positive processes. This is to be attributed to the artificial setting of the afferent patterns, and, particularly, to the fact that this setting acts—probably via the ego complex—to inhibit normal voluntary response. The stimulus pattern is similar to that of real life in some respects, but different in others. When positive retroflexes are set off, the novelty principle is aided by the essential retroflex tendency, both making for pleasantness; but when negative retroflexes are involved there is a conflict of the two forces. The reinforced perception of novel constellations of stimuli will tend to produce pleasure, whereas the negative retroflex process will operate in the direction of unpleasure. In the aesthetic situation or attitude, the former force is superior to the latter, so that the resultant effect, or affect, is pleasant. However, there are plenty of exceptions to this rule, for the negative force frequently predominates in certain phases of a tragedy. Stories with "unhappy endings" have a poor box-office value, other things being equal.

Another way in which the representation of human misfortunes on the printed page, the stage or the screen, can contribute to the greater happiness of the witness, lies through the ego complex. "Misery loves company." The novel or the movie help us by distracting our attention from our own troubles, even if they do so only by showing us someone else who is "worse off." When we read of a horrible accident, we are "glad that we were not in it." Our ego is exalted relatively to those who are even less favored in life than ourselves.

216. *The Basis of Musical Enjoyment*

One of the most persistent sources of pleasure among human beings is *music*. Attempts have been made to account for the pleasantness of melody and harmony by regarding them as modified representations of the voice of a sexual mate, thus providing their appeal with an erotic foundation. This explanation appears, however, to be quite far-fetched. It is unlikely that the affective sensibility to music has any direct biological significance. Its foundation is rather to be looked for in certain more or less accidental corollaries of the properties of the auditory cortex. It is well-known that specialized association areas are provided in the human cortex for the formation of auditory associations, to make possible the tremendous development of verbal association systems which is one of the outstanding peculiarities of the human mind. Hence, the auditory domain is one within which new associative pathways are formed with great facility.

Now, it seems almost a necessity that certain general modes of sequence of tones and accents should produce impressions upon the auditory cortex more rapidly than others; and we may suggest that the principles which control successful musical composition are based upon the discovery of these modes. However, the essential feature which governs the pleasantness of any given musical constellation is that of novelty. The continued repetition of any piece of music finally renders it substantially non-affective (except for the possibility that it has become a conditioner for some positive retroflex). The rapidity with which this affective adaptation sets in is greater, the simpler the form of the given musical composition, the less the novelty which it actually presented in the beginning, and the greater its failure to conform to the principles of good musical structure. The pleasure which can be derived from music is not independent of the degree and kind of preparation which the individual has received for the perception of the elementary forms which are employed. A study of the psychology of musical enjoyment indicates that the greatest pleasure is aroused when the simpler units in the composition are already familiar but their exact mode of concatenation is new. This applies to popular, as well as to classical music. The former is essentially stereotyped or familiar in its fundamentals of harmony and rhythm, only the melody being novel. Classical music, on the other hand, is frequently so complex as to furnish enjoyment only to those who have received a special musical education. Such persons are able to perceive a given classical composition in many different ways, so that it becomes for them a more enduring source of pleasure than is the case with the simpler popular forms.

The modern craze for jazz and dancing represents a combination of erotic and musical appeals in which the former is undoubtedly the most powerful. When combined with eating, as in a modern cabaret or night club, involving the alimentary retroflexes, the habit-forming and pleasure-producing possibilities of the system are tremendous. The modern musical comedy also unites the erotic and musical agencies in a highly effective manner. Music frequently becomes attached to particular retroflexes, sentiments or complexes in a conditioning relationship, and particular melodies may acquire a relatively permanent pleasantness—or possibly unpleasantness—in this manner. Such associations are, of course, attributable to special experiences, peculiar to given individuals; but may also be engendered for large groups of people through the medium of the lyrics which may be sung to a particular melody.

217. *Radio*

One of the most interesting motivational developments of modern technical science is that which is presented in radio broadcasting and reception. The motives of the broadcasters, themselves, are apparently those of business and possibly, to some extent, of the unadorned ego complex. Radio provides the listener with all kinds of music with the expenditure of very little effort or money. It furnishes the greatest attainable auditory novelty. However, to the experimentally-minded person, radio offers the materials for an infinite variety of experiences of a more intellectual kind. Owing to the complexity of the principles which it embodies, a vast number of different combinations of elements, having surprising results, are possible. Then, too, the circumstances of radio reception may make a powerful appeal to the ego complex. If a man constructs his own receiving set, the supposed excellence of its performance is a proof of superior ability in this field of work. There are so many different ways in which one radio set can excel another—in selectivity, distance-getting ability, power, quality, ease of manipulation, etc.—that it is usually easy to believe that one's own set is better than that of his neighbor. The lure of "DX"—to dance in Boston to the rhythm of music played in San Francisco, the conquest of distance—also makes a powerful appeal to the ego. While this was a real novelty, it provided one of the greatest thrills which the human mind has yet experienced.

Chapter XXVII

Personality, Character and Temperament

It should be evident that the principles which have been laid down in preceding chapters furnish a basis for understanding the differences which are observable, in the human and other species, between the modes of response of different individuals to the same stimuli. Such differences can be attributed, as usual, to the resultant action of the two general forces: heredity and environment. It is to be assumed that if two individuals with identical heredity are subjected to identical stimulus histories, their personalities will remain continuously identical, no matter how complex these personalities may become. This proposition rests, of course, upon the assumption of strict determinism which is characteristic of all scientific thinking. There is no such thing as freedom of the will, in the sense that volitional processes are ever undetermined. This proposition has not been proven empirically with complete precision, and probably it never will be; but it is the only basis upon which we can hope to develop a scientific understanding of response and the experiences which accompany the latter.

218. *Definitions of the Personality Concepts*

The words, personality, character and temperament, which are frequently used to designate individual tendencies of action and feeling, are, unfortunately, ambiguous and complex in their connotations. In order to utilize them satisfactorily in a scientific discussion, they must be redefined. However, they are really not necessary to the development of a general theory of motivation such as the one which we have propounded in the present book. Character, in common parlance, means "good" or "strong" character, a set of response tendencies which are socially commendable. Personality usually implies uniqueness or impressiveness; and "temperament" suggests undue emotionality. From a more technical standpoint, such as that adopted by Kant in his *Anthropologie,*[204] temperament stands for the characteristic *affective* dispositions or reactions of the given individual, whereas character denotes his specific tendencies to volition or action. Roback, in his recent scholarly work on *The Psychology of Character*[205] defines temperament as "the sum-total of one's affective qualities as they impress others," and character as "the characteristic mode of human behavior in that sphere which distinguishes man from animals." "Personality is the sum-total of all of our cognitive, affective, conative, and even physical tendencies." "Character is that part of the personality which remains after the cognitive, affective, and physical qualities have been abstracted."

219. *General Constituents of Personality*

From the standpoint of the theory advocated in the present book, any individual personality may be regarded somewhat as follows. Firstly, on the psychological side, each individual has an hereditary endowment of reflex, retroflex and other less differentiated nervous mechanisms—such as the cortex—which undoubtedly vary quantitatively as regards excitability, susceptibility to change, conditioning, etc., upon a purely genetic basis. The operation of what is usually called "experience" or "environment" upon these hereditarily supplied materials is divisible into a number of fairly distinct components. In the first place, *afferent impressions,* representing specific stimuli or stimulus situations, are made upon the sensory side of the cortex. The inherent patterns, and also the patterns of external concatenation, of these neurograms are determined primarily by those of the external stimuli, although this is done in a cumulative manner, according to patterns already laid down which modify the nature of those which are superimposed upon them.

In the second place, some, if not all, of the constituents in this neurogram system are particularly associated with special modes of cortical or "voluntary" efferent innervation, and, hence, of muscular reaction. Each afferent to efferent combination of this sort comprises a specific response mechanism. These mechanisms, like those of the neurogram system, may be arranged into complicated, interlocking and organized schemes. Thirdly, there is another type of specific linkage which, this time, operates between particular neurogram units and the retroflex centers, constituting the mechanisms for specific conditioned retroflexes. Fourthly, closely related to the latter, there is a specific linkage between neurogram units and reflex or "involuntary" efferent innervations, forming conditioned reflexes.

This quadruplex development will never, by any chance, be identical in separate individuals. Even if their hereditary endowments were the same, it is practically impossible for two individuals to be acted upon by exactly the same sequence of stimulus forces. Their afferent cortical impressions will therefore be different, and the "voluntary" innervations which are attached to various of these impressions will be individually characteristic. The exact manner of conditioning of the several retroflex mechanisms will vary, and with this variation will go a corresponding variation in the conditioning of the reflex innervations. Accordingly, each individual will possess a characteristic, idiosyncratic, *action system,* which will determine what he does and how he feels under any given circumstances. It is clear that a man's action system constitutes the (relatively) permanent basis of his motivations; and that differences between such action systems furnish the explanation for differences between the motivational forces which operate in different individuals under the same stimulus conditions.

Now, if we look at this matter from the standpoint of introspective psychology, we shall be able to observe certain phenomena of consciousness which are attributable psycho-physically to the nature of the action system. The exact form of the perceptions of the moment will depend, not only upon the concurrent patterns of excitation of the sense-organs, but upon the prepared neurograms in the cortex. The associatively aroused images will be completely determined by the cortical interconnections of these neurograms, as will the volitional impulses which appear in consciousness in the form of kinaesthetic representations. The accompanying affections will be controlled either by the state of relative conductance saturation of these neurograms or—more importantly—by their retroflex associates. These retroflex associations will also assist in governing the degree of excitation of the corresponding neurograms. Certain accompanying sensations will be determined in character by associated *re*flex activities. The individual may be said to observe his own personality from within, in the course of his introspective experience, whereas other people can observe it from without, in the progress of his behavior.

The above analysis provides us with the requisite ideas for distinctions between personality, character and temperament. Personality may be identified with the entire action system, and the uniformities of experience which it underlies. Character may be permitted to denote the system of established specific response mechanisms, together with the corresponding psychical phenomena; while temperament can stand for the system of conditioned retroflexes and associated uniformities of affective experience.

220. *Types and Dimensions of Personality*

This view of human personality evidently does not demand that there should be any very definitely separable *types* of character or temperament, such as are indicated, perhaps, by the classical division into the sanguine, melancholic, choleric and phlegmatic. A biometric frequency distribution graph of personality characteristics should not be multimodal. Instead, we should expect to find a situation similar to that depicted by Bucke, in his *Book of Human Character,*[206] wherein he "treats of persons whom it is difficult to know, who see clearly and yet represent superficially, those who spin too finely, those who can do little things greatly, those who waste great powers on subordinate subjects, whose politeness is altered by the mention of money, who think too much about the past, who are always concerning themselves about the future, who believe their own lies, who break off in the middle, who have elegant manners but vulgar minds, who are cruel in general yet clement in particular, who suspend their natural characters, who being innocent have no regard to appearances, etc."

Nevertheless, our theory provides a very definite basis for the analysis of each of these peculiar personality structures into a limited number of elementary components and relational forms, so that they can all be understood in terms of a few fundamental principles. Although we should not expect clear-cut types of personality, we should, at least, be able to demonstrate the existence of a number of distinct variational dimensions. This idea underlies what is probably the dominant method of personality analysis in contemporary studies of this subject. Such dimensions will be determined primarily by the varying degrees to which the several retroflex mechanisms are involved in the motivational constitution of the given individual; although other considerations must also be included, as we shall see. It is easy to appreciate that in one individual history the part played by the pain retroflex, for example, may be very much more extensive than that which it plays in some other individual history. A person may be born with an organic defect which causes pain or increases sensitivity to algesic stimuli; or, on the other hand, he may be placed in an extremely harsh environment. Some other person may be particularly exposed to erotic excitation. Accordingly, we might expect the first individual to have a "melancholic" temperament, whereas the second one should exhibit an erotic temperament. The characteristics of specific retroflex mechanisms are impressed, not only upon the affective or inhibition-facilitation life of the individual, but also upon his system of responses. This is because the vast majority of responses are selected and laid down primarily through the influence of one retroflex process or another, or by groups of such processes acting in specific combinations (complexes). Hence it should be possible to pick out of any action personality a cluster of response mechanisms which are a consequence of erotic history, another cluster which are developments of pain, another for the alimentary system, and so on.

From this point of view, we might look for as many types of temperament or character as there are unit retroflexes. The number of types would certainly be greater on this basis than that indicated by the classical fourfold division. It would include the following: firstly, a nociceptive list, embracing (1) the algesic (pain), (2) the hungry, (3) the thirsty, (4) the negative gustatory (bitter, strong sour and strong salt), (5) the negative olfactory (unpleasant odors), (6) the negative thermal (primarily cold), (7) the disgusted (nausea), (8) the micturitional, (9) the defecatory, (10) the respiratory, (11) the lactational, and to these we might have to add (12) the negative erotic, and (13) the bored, (14) the tired (fatigue and sleep); and a beneceptive group, comprising (15) the positive erotic, (16) the saccharine or positive gustatory (including weak sour and salty), (17) the positive olfactory (pleasant odors), (18) the positive thermal (primarily warmth), (19) the satiated (full stomach), (20) the euphoric (coenaesthesia). If we group the above systems in accordance with their physiological affinities, the corresponding number of separate types or lines of personality variation might be reduced to the following: (a) the algesic, (b) the erotic, (c) the ingestive, (d) the digestive, (e) the excretory, (f) the respiratory, (g) the thermal, (h) the lactational (i) the uneasy, (j) the fatigued and (k) the euphoric.

It is likely in particular cases that particular tendencies among those which have been listed above will predominate to an outstanding degree in the determination of personality, although, in general, we should expect to find a balanced proportioning of all of these tendencies. This proportion would follow a formula depending upon the average relative biological importances of the several retroflex processes. Our suggestions as to the dimensions of temperament or character may be regarded as being based upon modern physiological notions in a manner quite analogous to that in which the four classical temperaments are derived from the ancient doctrine of humors. The views of Sigaud,[207] who distinguishes between four types of man, as respiratory, digestive, muscular and cerebral, respectively, are along similar, but less definite lines. We may also mention the observations of Kretschmer[208] regarding the supposed relationships of physique and character. However, it by no means follows from our theory, that the physiologically determined types or dimensions have any reliable relationships to externally obvious physical features, such as those of physiognomy, cranial contour, or general gross anatomy. In the majority of cases, the emphasis upon one retroflex system or another will depend entirely upon environmental influences which will exert no very great effect upon the nonnervous anatomy. Even where the basis of special effects is hereditary, it may be exclusively neurological and show no correlation with other aspects of anatomical structure. We cannot, however, deny the possibility of such correlations.

221. *Congenital Variations Affecting Personality*

Up to the present chapter, our discussion of the problems of motivation may seem to have been based upon the assumption that all men are created equal, if not free. We are certainly justified in supposing that all human beings are supplied with the same retroflex devices, the same sense-organs, the same cortical association apparatus, etc., unless there is definitely evidence to the contrary in particular cases. Even if the hereditary nature of these fundamental materials were precisely identical in all individuals of the same species, difference in the consequences of their operation would, of course, be expected because of the many different ways in which they would be guided by diverse environmental conditions in the building up of habits, sentiments, complexes, etc. It would be absurd, however, not to recognize that *quantitative* hereditary differences are inevitable in all of the nervous mechanisms, when we compare the congenital equipments of separate individuals. The restriction of such variation to quantitative, as opposed to qualitative form, is probably justified in spite of the theoretical possibility of mutations, because of the complexity or biological stability (importance) of the structures which are concerned. It would certainly be highly extraordinary for an individual to appear with a new retroflex system which is not represented to any degree among other members of the same species, or for any individual to lose such a system completely. However, it would not be surprising if, of two individuals, one should be found to show one-half or even one-quarter the development of a certain retroflex tendency which is manifested by the other individual.

Such quantitative variations in the retroflexes may be of various sorts. First, there is the question as to how readily the retroflex is aroused through its primary nociceptive or beneceptive channel; second, as to how intensive is its action (the rate at which it changes cortical conductances) upon the cortex for a unit degree of arousal; third, as to how readily it is conditioned; fourth, as to how intensely it can be set off conditionally; and, furthermore, as to the degree to which it reinforces the excitation of its conditioning neurograms (perseveration), under standard conditions. Other variables involved in retroflex action or their underlying mechanisms can probably be demonstrated. Each such variable will have a definite value for each retroflex system, and there will not necessarily be any correlation between any of the factors comprising this multitude of hereditary determinants. On the other hand, it is possible that such a property as retroflex excitability may be a "general factor"

—in Spearman's [209] sense—for all of the retroflexes. This would be the case if the thalamic mechanism by which the cortex is inhibited or facilitated is identical for all of the retroflexes; although the afferent channels of excitation of this mechanism are diverse and the cortical records are specific.

In addition to such quantitative differences in the congenital properties of the retroflexes, we may look for analogous differences in the properties of the sense-organs, the cortex, the lower center motor coördination apparatus, the subcortical reflex mechanisms, etc. With regard to the cortex, it is to be presumed that it will show hereditary variations in impressibility on the afferent side; in retentiveness (inverse rate of neurogram decay), in the coherence of extensive neurogram integrations (associations of ideas), in the lability of such systems (imagination), etc. On the motor side of the cortex, we may expect to find different degrees of efficiency regarding the ease with which new efferent innervation patterns are formed, the degree of coördination achievable in such innervations, etc. With regard to "adjustment," or the combination of these two phases of the cortical process, there may be differences in the facility with which new afferent to efferent unions arise, their accessibility to retroflex action, their tendency to decay spontaneously, and so on. It is entirely conceivable that these characteristics may differ for different kinds of sensory and motor processes. For example, between visual and auditory on the sensory side and between speech-motor and manual on the efferent side. On the other hand, it is conceivable that some of these properties may be general for the entire cortical substance.

All such quantitative features will obviously combine with the operations of "experience," to determine the exact character of the action system of any individual at any time during his life. Since the retroflexes, and the nervous system in general, show maturation, or ontogenetic development subsequently to birth, specific differences in maturation processes will also play a part. Thus, an individual whose erotic sensibilities develop very rapidly will be subject to facilitation by these processes at an earlier age than will another individual. Thus, he may not only be exposed to these influences over a longer period, but they will operate in combination with the stimuli and physiological conditions which are characteristic of an earlier period of life. This may confirm him in erotic and other habits which are of a comparatively infantile nature. The exact histories of the retroflexes in later life will also prove to be of importance. In woman, the time and exact physiological character of the climacteric and in man, the degree of lapse of the erotic excitability in old age are examples.

222. *The Treatment of "Faculties"*

Classical psychology, which has been emulated rather persistently by more modern views, purports to analyze mentality into a number of supposedly distinct faculties, such as sensory perception, intellect, memory, imagination, attention, language, and movement.[210] The efficiency of each of these faculties may be regarded as variable from one individual to another. Now all of the faculties are most certainly susceptible of interpretation in terms of the nature of the cortical adjustor process and its correlated consciousness, but it does not seem likely that they are separable structural or even functional unities, as they are ordinarily conceived to be. They appear when the neuropsychic system is viewed in the light of certain theoretical definitions or practical requirements. The treatment of the faculties will need to be similar to that which is accorded to the so-called "properties" of matter in general, such as weight, mass, elasticity, plasticity, dielectric capacity, etc. All of these properties are "real" or actually descriptive of matter, but they are individual only because a concept or method has been invented for abstracting or measuring them. Other concepts could be defined with equal facility which would divide the attributes either of matter or of cerebral functioning along different lines of cleavage. Our choice among such alternative sets of conceptions must be determined by their fruitfulness in yielding simplicity in systematic description, and maximal utility in practical application.

However, ordinarily, this process of abstracting supposedly unitary attributes of psychophysiological activity is particularly likely to be based upon general biological or upon social criteria. The results which are obtained by the attempted scientific application of such concepts are usually very difficult to interpret from a psychological standpoint. The notions of intelligence and of virtuousness are outstanding examples of this fact. "Intelligence" can be defined quite satisfactorily from the practical standpoint as a man's ability to solve new problems, and may be said to increase in proportion to the difficulty of the problems and the speed and accuracy of the solutions. There are, however, so many different kinds of new problems, and so many different ways of solving them that intelligence appears to be a very composite affair, when its intrinsic mechanism is examined. It is easy to see that intelligence demands a coöperation of perception, intellect, memory, imagination, attention, and practically all other recognized psychophysical attributes, in some particular manner which will yield the most desirable results in connection with a given problem. And it is very doubtful whether any general psychological formula can be written for this mode of combination which will apply to all possible situations. The similarity between different applications of "intelligence" lies in the results rather than in the causes. It is notorious that similar effects may follow from widely dissimilar causes. Yet it is possible to gràde men in respect to the trait of intelligence for a particular kind or group of problems.

Similarly, the moral evaluation of personality is based upon the bearing of a man's behavior upon the welfare of his fellows, but with special reference to cases where his own advantage is in conflict with that of others, and also with reference to innumerable traditional principles of ethics. It is, therefore, not to be expected that "good" and "bad" character will correlate with any very elementary features of psychological constitution. The man of high moral character is apt to be one with plenty of fear of the opinions of his fellow-men, with a well-developed ego complex and relatively low eroticism. He may also be aided by economic success in lines of work which are socially approved, and hence by being "intelligent." On the other hand, his virtuousness may be supported by an excessive stupidity.

223. *Extraversion and Introversion*

Numerous intriguing dichotomies or "antitypes" of character and temperament have been suggested and vigorously advocated as keys to the complete understanding of the problems of personality. One of the most popular of these at the present time is that between the extravert and the introvert, which is taken from the psychiatric theorizing of Jung.[211] Each of these supposed types, or extremes of variation, is supposed to be characterized by a long list of more or less antithetical tendencies of feeling and behavior. The outstanding feature of the extravert personality is that of attending and reacting to the world outside of him, with comparatively little reference to himself or his relation to the world; whereas the introvert is preoccupied with perceptions and ideas of himself and reacts in a minimal degree to the things about him. Jung finally found himself compelled to differentiate between eight distinct types, because of the apparent fact that individuals might be separately extraverted or introverted with respect to the faculties of sensation, thought, feeling, or "intuition."

A careful consideration of the actual facts which Jung and others have examined under the heading of introversion-extraversion, indicates that there is really nothing very unitary about the group of characteristics which are alleged to be exhibited by these contrasted types. However, they represent response tendencies which seem to occur together more frequently than might be expected upon a purely chance basis; and it is quite possible that we may eventually be able to trace this loading of probabilities to the action of some relatively simple agency, under suitable circumstances. McDougall's [212] explanation, in terms of an hereditary endocrine constitution, seems highly questionable as a general theory. We might suppose that individuals having a constitution of the ego complex which involves an excessive excitation of the pain retroflex, in the inferiority phase, will tend to become introverted. Such a condition might underlie an extreme perseveration of the idea of their own relationship to society, and this idea being highly unpleasant, they shrink from all situations and behavior which might lead to a perceptual excitation of the supersensitive inferiority image. The extravert, on the other hand, may be unduly devoid of ego sensibility, or may have an hypertrophied superiority phase which facilitates his social relationships.

224. *Conflict and Psychopathic Constitutions*

One of the most important questions regarding the make-up of a personality or action system has to do with the amount of *conflict* which it comprises. It will be obvious from our discussion of conflict that this condition can be built into the functional nervous constitution of the individual. Conflict will be particularly in evidence when the same or closely related ideas operate to condition positive and negative retroflexes simultaneously. This condition, or the corresponding action of a peculiar stimulus constitution of the environment, tends to disintegrate the personality by breaking up the "cross-conductional" linkages between neurogram components in the cortex. On the other hand, the degree of associative integration of a personality may vary independently of conflict, and may sometimes be quite high when there is a good deal of the latter. The best integrated types of personality involve a definitely hierarchical organization of the retroflex forces about some dominating image, or "life-purpose," which is ordinarily the powerful conditioner of a well-knit ego complex.

It may be appropriate, at this point, to make a few general comments concerning the application of retroflex theory to the problems of psychopathology, although we have already presented a considerable number of such applications, incidentally. Psychopathic states may be divided into those which are attributable to the abnormal or excessive operation of motivational forces, and, on the other hand, those which are due to degenerations or lesions of nervous tissue and the consequent disturbance of more general (but sometimes more special but non-motivational) neurological functions. The former class of disturbances are usually known as *functional,* and have proven to be susceptible of explanation along the lines of motivational theory, such as those followed for the most part by McDougall in his *Outline of Abnormal Psychology,* to which the reader is referred for many illuminating analyses and cases.

In many instances, functional abnormalities are not really psychopathic, but only non-adaptive or unsocial. This statement applies to a great many cases of phobia, compulsion and sexual perversion, where powerful motivational forces have been set into operation by agencies which do not have the normal relationship to biological or social utility. From the purely psychophysical standpoint, there is no greater abnormality in being thrown into a paroxysm of fear by the sight of an innocent maltese cat than in undergoing a similar process while tottering on the edge of a precipice. Homosexuality and various forms of erotic fetichism have a similar status with respect to so-called normal heterosexuality. However, the disorders, such as hysteria, which depend upon true *repression* must be regarded as being functionally pathological, although resting primarily upon the operation of natural neurological forces. The phenomena of "automatism," somnambulisms, fits, fugues, etc., can be accounted for as motor expressions of more or less minor dissociated portions of a personality. Delusions and hallucinations are consequences of similar conditions operating upon the afferent-side processes of the cortex.

The manner of explanation of these effects in terms of retroflex theory is generally similar in form to that followed by Prince, McDougall, Freud and others of the psychological or psychoanalytical schools.

The psychopathic phenomena which accompany chronic alcoholism, the advanced stages of syphilis, shock and mechanical injury to the cortex, and other degenerative processes must be interpreted in terms of more general neurological variables. However, such constitutional alterations will, of course, have a bearing upon the manner of operation of the motivational agencies, and will ordinarily alter their balance in the make-up and control of the personality. Dementia praecox presumably rests upon a degenerative process which is due to a congenital tissue instability, but—as in the case of general paresis—many of its characteristic symptoms indicate an unbalanced activity of the ego complex. In paresis, the superiority phase usually becomes predominant (in euphoria and delusions of grandeur), whereas in the paranoiac form of dementia praecox there is more likely to be an undue reinforcement of the inferiority phase,—corresponding to the commonly introverted personalities of the individuals who are most susceptible to this latter disease. In manic-depressive insanity there appears to be a periodic alternation between positive and negative retroflex forces, acting with undue violence and in combination with more general functional disturbances.

225. *Résumé*

The above discussion of personality is not intended as a disparagement of all plans for classifying character and temperament, but rather to indicate that the problem is extremely complex and is not likely to be solved by the establishment of supposedly clear-cut types or species. The problem is analytical rather than classificatory, and the primary task is to discover the psychologically elementary traits or dimensions of personality—which are certainly not obvious either in behavior or consciousness. The place where we must look for direct evidence as to the identity of these traits is in analytical physiology, rather than in introspective or behavioristic psychology. If, however, the approach must be made from the psychological angle, then the methods which are now being applied by Spearman [213] will probably prove to be most fruitful. We must always bear in mind that no matter what the elementary constituents of human personality may turn out to be, they will be partitioned in many different ways among a diversity of stimuli, in accordance with the individual history of the given person.

Chapter XXVIII

The Theory of Correct Conduct

Problems regarding human feeling and behavior have divided themselves, for both popular and philosophic thought, into two sharply contrasted groups. One of these groups comprises the questions, such as those which we have discussed in the body of the present book, as to the underlying causes of particular kinds of action or feeling. The other class of problems is concerned with what we may call the "correctness" of given responses, or even feelings. On the one hand, we ask *why* a man acts as he does, whereas on the other hand, we inquire as to whether his behavior is "right." The first question raises a psychophysiological problem, whereas the second question propounds an ethical one.

226. *The Difficulties of "Scientific" Ethics*

Now a great deal more thought, and an infinitely greater number of words, have been expended upon the problems of ethics than upon those of motivation. However, it may perhaps be said with justice that the amount of progress which has been made upon the two classes of problems up to recently has been about equal. The theory of motives has naturally been taken over by psychology and, consequently, of late has been regarded as amenable to scientific treatment. Ethics still holds its original status as a subdivision of philosophy in general, and is not ordinarily considered to be a science, but is classed as a "normative" discipline, which deals with standards rather than with facts. Naturally, but unfortunately, there are nearly as many different systems of ethics as there are ethical authors.

We can hardly doubt that the problem of ethics is the most important one with which the human mind is faced. We may even assert, with small fear of refutation, that it is the *only* important problem. Knowledge is useful only insofar as it enables us to determine our behavior correctly; so that, in a practical sense, all branches of human inquiry are subordinate to ethics. Purely theoretical and entirely unapplied knowledge can have no value. When we contemplate contemporary human life, we perceive that it is not so "good" as it might be, that it is capable of being "improved,"—we favor "progress,"—and ethics should tell us, at least in a general way, what these words mean and how their meanings can be realized.

The fact that the ethical teachings of different philosophers and preachers vary so widely, and that there is no analytical system of ethics which bears the stamp of approval of a large consensus of superior intellects, may lead us to suspect that the trouble with ethical inquiry lies in its failure to utilize scientific methods. The same sort of chaos of opinion existed with respect to physical principles prior to the days of Galileo; and still exists, in a rapidly diminishing degree, with regard to psychological questions. The gradual development of agreement with reference to the problems of mind is attributable to the introduction of scientific procedure in the study of mental phenomena. Why should not a similar step be taken in connection with ethical problems? Why not take ethics away from the mothering bosom of philosophy, just as psychology was so recently taken?

When we consider this plan we immediately become subject to serious perplexities. Science seems to be characterized exclusively by its intention to formulate a precise, analytical account of *facts*. It deals either with things which are empirically demonstrable, or with logical developments from the descriptions of such things. It does not purport to establish normative formulae. The essential problem of ethics, on the other hand, appears to be that of discovering how we can *improve* upon the actual facts of life. At first thought, it seems as if the only way in which we can reduce the problem of correct behavior to one of actual behavior is to identify the problems of ethics with those of motivation. In this case ethics seems to vanish as a distinctive line of inquiry.

227. *The Problem of the "Meaning of Right"*

However, these considerations do not show us, at once, how we can avoid recognizing certain actual facts of human life which support the idea of ethics as a normative discipline. In the first place, there is the fact that moral conceptions are actually in use, and have a very important bearing upon the nature and control of human responses. Such words as "good," "bad," "right," "wrong," "duty," "ought," "better," "worse," "improve," and "progress" seem to be very difficult to avoid, either in popular or in scientific discussion. Secondly, we have the fact that in practically every line of human endeavor, "normative" standards or ideas are involved, and represent non-existent ends towards the realization of which the endeavor is directed. This is true, even of such a commonplace process as building a house, where the structure is visualized and represented in great detail in blue-prints before the ground is even broken. It is particularly characteristic of industrial research, which is directed towards the development of new material products or processes. And no matter how "good" the house may be when it is completed, we can always see how it might have been "better," and no industrial product is ever sufficiently good to be regarded as final. This attitude is characteristic of what we call "applied science," engineering, or *technology*.

Accordingly, we are forced to recognize that we habitually, and, apparently, of necessity, employ a normative terminology which assists in guiding our responses, but concerning the factual meaning of which there is much obscurity. This obscurity explains why ethical inquiry has usually begun with an investigation of "the *meaning* of right and good," rather than as to how to secure the good. The majority of ethical works are devoted exclusively to this definitional problem with its many subdivisions.

Now this problem can be interpreted in a number of different ways, some of which make it amenable to scientific treatment, whereas others place it quite beyond the pale of science. A great many ethical students deal with the problem, explicitly or implicitly, in accordance with the postulates of Platonic Idealism, according to which concepts are entities which can exist independently of both language or particular concrete instances. This view is entirely non-scientific, and is a consequence of the common delusion that "whatever receives a name must be an entity or being, having an independent existence of its own," to quote J. S. Mill,[214] who continues: "And if no real entity answering to the name is to be found, men did not for that reason suppose that none existed, but imagined that it was something peculiarly abstruse and mysterious." The intellectual pursuit of such mysteries can lead us nowhere.

Another interpretation of the questions, "What is the meaning of right?" or "What is the meaning of good?" would lead to an investigation of these meanings in particular concrete minds. We might ask a large number of individuals to tell us what facts, if any, they associate with ethical words, as meanings. This is the method which is actually employed by almost all ethical investigators, except for the fact that they are inclined to limit the introspective process to the contents of their own experiences, while, at the same time, failing to recognize that the process is purely psychological and individualistic. However, the definitions of ethical terms which are developed in this manner are as diverse as are extant systems of ethics. It is natural that such introspective results should not agree, since the associative connections of moral ideas in particular minds must depend upon the individual histories of these minds, which are different one from another. Frequently, one ethical conception, such as "right" is defined in terms of other equally ambiguous conceptions, so that the final outcome may perhaps be a well-rounded symbolic system, but one which fails to connect with any facts. At other times, this system of words is joined to non-verbal introspective contents, such as satisfaction, interest, affection, emotion, self-realization, and the like. A critical examination of such results might very well lead us to some definite conclusion.

228. *Anthropological Ethics*

Another method of attack upon the question is that provided by anthropology or its sub-sciences, ethnology and philology. We can regard "moral ideas" as sociological facts which are to be explained by means of evolutionary principles. As we have already seen, moral judgments become powerful conditioners of retroflex mechanisms and thus assist the social organization to control the behavior of the individual. It is not necessary, in order that moral ideas should operate in this manner, that they should have any meaning in the logical sense. Their meaning, psychologically, lies in the sentiments or feelings which they excite, and in their actual influence upon response, although such meanings do not prove to be intellectually acceptable. The "right," in such terms, is that which—if done—will be rewarded by social approval; and the "wrong," that which—if pursued—will lead to punishment. But why does "society" choose to reward certain lines of behavior and to penalize others? Obviously, from the biological standpoint, because some kinds of conduct on the part of individual members of society are detrimental to the continued existence of the social organization, whereas other kinds of conduct are beneficial to the latter. No further reason for the existence of the ethical concepts needs to be assigned, and these concepts are thus reduced to the status of mere biological instruments, where they can have no more scientific or philosophical significance than have lungs, kidneys, or any other organ which is requisite to survival. This is the conclusion which is reached by Levy-Bruhl, Westermarck and other anthropological students of the "origin and development of moral ideas."

Although we are not compelled to accept this explanation of moral concepts as final, we are certainly forced to regard it as being true so far as it goes, and as disclosing the true source of moral thinking, whatever may be its ultimate destiny. In accordance with such a biological account, the sanctions of morality are limited to the particular social group to which the moralized individual belongs. In general, it is a fact that the dictates of practical morality do not extend beyond this group so as to minister to the welfare of other social organizations. Indeed, group morality usually demands action which is positively prejudicial to the biological welfare of foreign communities. In modern times the unit group appears to be the nation, or any combination of economically interdependent nations. When this economic relationship is suspended by a state of war, there is virtually a complete abrogation of all moral principles in application to relationships between two nations or their individual members. In some dim future, a phase of evolution may be reached in which the morality group comprises the entire human race; but even then—from the purely biological standpoint—the determining sanction of morality could only be that of existence, as symbolized by the largest possible human population of the globe, at the expense of other animal or of plant species.

229. *Instrumental Ethics*

Although some ethical theorists regard "righteousness" as an intrinsic characteristic of certain kinds of conduct, the majority view the ideas of "right" and "wrong" as being of secondary ethical significance, and as deriving from the more fundamental concept of "good" or "value." The value may be happiness, the satisfaction of interest, the attainment of truth, development, or other things; but instrumentalistic ethics would always deduce "right and wrong" from a consideration of the fruitfulness of any particular kind of behavior in generating (or perhaps destroying) the preferred kind of value. The value in the anthropological argument is the survival of the group, and anything is right which is instrumental to this result. However, in biological morality the reference to group survival as the determining value is not expressed in the moral system itself, and hence cannot be regarded as providing its logical foundation. Morality in this instance has a function, but no purpose.

These notions of value and instrumentality are characteristic of the situation, which we have considered above, in which engineering science determines preferred lines of action, and judges the outcome in relation to scientifically established standards. Every problem in applied science is a problem as to *how to produce* something which does not then exist; but the problem is solved, if at all, by the use of our knowledge of things which do exist, the materials and laws which compose the physical or psychical worlds. However, the manner in which the engineer utilizes this knowledge is determined by his *purpose*. The combination of purpose and theoretical principles provides a set of rules for the guidance of his behavior to the desired end, and creates a normative system which is applicable to the given special situation.

Now, we have already discussed the psychophysiology of purposes in considerable detail, and we have seen that they are images which seem to control the course of an emotional or action experience, and which represent the perceptions which may finally satisfy the trend of such experiences. The purposes of the engineer are given in the same manner. (See our analysis of engineering motivation in a previous chapter.) Engineering purposes, however, can be represented more precisely and at the same time more abstractly. The purposes of an engineer, who is in charge of the design and construction of a bridge, are embodied in drawings and mathematical computations, but they are also represented in the general principles of "good" mechanical engineering practice. In the construction of the bridge, his purpose is to combine strength, lightness and permanency to a *maximal* degree. This purpose is supported by an ulterior one of producing the greatest utility for the least cost; and this, again, by that of the demands of the community which the bridge is to serve.

230. *"Complete Technology" and the Hierarchy of Purposes*

It is apparently characteristic of technological work that each purpose is subordinate to another purpose which is more comprehensive. All of the details in the design and construction of the bridge are thus subordinate to its general plan, while the general plan is subservient to the principles of good bridge building, and the latter to the demands of maximal economic utility. Each of these phases is characterized by a relationship of instrumentality to its superior, and each superior phase governs a number of inferior phases, so that the system tends to converge from below upwards. The instrumentality relationship is of the so-called asymmetrical, transitive type according to which the purposiveness is derived entirely from the most ultimate and comprehensive members in the system.

Now the regressus toward the ultimate purpose is characterized, not only by an increase in the comprehensiveness of the members, but also, unfortunately, by a proportional decrease in their clearness. The "demands" or the "happiness" of the community are much more difficult to observe, localize, or even to define than is the detailed sketch of a particular portion of the bridge. Also, the exact form of the relationship between the successive members of the hierarchy becomes vaguer as we consider the more comprehensive ones. If there is a final and all-comprehensive purpose in this system it is so unclear as to be substantially inaccessible to ordinary methods of observation. It is as if we could see many sharply defined minarets projecting into the air, with supporting structures partially veiled in mist, while the foundations of the architectural assembly are obscured by dense fog.

We have seen enough, however, to enable us to formulate a scientific discipline which we may call *complete technology*. Ordinary technology is characterized by the application of scientific knowledge to the quantitative realization of certain purposes which are clearly defined and have definitely deducible consequences in combination with scientific data. They are always, however, subordinate to other purposes of a higher order. Present technology is *in*complete in the sense that the total purposive hierarchy is not clearly established, and such deductions as are made from higher order purposes are seldom quantitative in character. Complete technology would involve a clear cognition of the total hierarchical system, followed by a strictly logical and mathematical deduction of all of the steps in the purposive argument. In such a system there would really be only one independently effective purpose, all subsidiary purposes being logical consequences of this highest purpose in combination with empirically determined facts or principles. If pedestrians or vehicles could cross a river without having solid support, there would be no bridge-building purpose.

The hypothetical primary or ultimate purpose of complete technology may be designated as the *dominant desideratum*. If we conceive the latter in harmony with engineering tendencies, we must regard it as a quantitative fact or concept which can be treated as a mathematical variable. The function of technology in all of its ramifications must be to bring this variable to a maximal value. It presumably has some definite value in every case—whether or not technologically controlled—so that the sole duty of technology consists in increasing it, or in raising the efficiency of human effort, as measured by the degree of attainment of this desideratum. The notion of a maximum naturally implies that of limitation, and the operative limitations, in the case of the dominant desideratum, are to be found in the manner in which the value of the latter depends upon the scientific facts which technology combines with the notion of the desideratum, in deducing subordinate purposes and concrete procedures. Each stage in the purposive deduction is, in fact, a computation of the conditions for a maximum of the dominant desideratum, or some of its accessories, in accordance with the principles laid down by the differential calculus.

231. *The Relations between Complete Technology and Ethics*

Now this conception of complete technology evidently bears some resemblance to that of ethics, as the latter is conceived by thinkers of the instrumentalist type. It contemplates a system of deductions and practical imperatives based upon a dominant purpose and the conditions which limit the realization of this purpose. Our "dominant desideratum" may be regarded as analogous to the familiar conception of the "summum bonum," or ultimate value. "Right" conduct is that which is demanded by technologicai deduction in order to realize the fundamental purpose tc the maximal degree. However, the concept of complete technology differs from that of ethics in the usual sense in that it does not restrict the practical imperatives to any particular domain of behavior. Ethics has been concerned mainly with the competition between individuals in the social order, and has attempted to regulate this competition by moral suasion and precepts, which operate upon the motivational systems of the individuals in question.

Complete technology is concerned with all possible means of realizing the dominant desideratum, regardless of whether they are sociological, psychological, physical or what not. The invention and propagation of moral principles may turn out to be one of its essential tasks, but this will have no different status from that of such methods as changing human nature by eugenic control, suppressing disease, building bridges, and doing an infinite number of other things which will undoubtedly be required in the pursuit of its general purpose. It will almost certainly appear that, while the problems which ethics has primarily considered are much more important than those which now concern technology, nevertheless the practical methods of ethics—the propagation of moral principles—are not very efficient ways of realizing the ends towards which they are presumably directed.

But the concept of ethics is so poorly established in general, although so rigorously sanctified along particular lines in various philosophic minds, that there seems to be nothing to gain and everything to lose by advocating complete technology as its *equivalent*. Therefore, we shall offer complete technology as a *substitute for ethics*. In this way, we can avoid the possibility of being compelled to waste words in a futile argument concerning the question as to whether or not it is really ethical.

However, complete technology evidently resembles ethics further in that it appears to be concerned primarily with things which do not exist, namely, with standards, things to be done, or achieved, etc. Nevertheless, it should be noted that—as we have defined it—complete technology is a deductive system the foundations of which are exclusively existential. Applied science is not based at any point upon *a priori* premises, universals, or any other transcendental ideas. The processes of building a bridge are logically developed from two realities, first, the data of mechanics, and second, the purpose to have a bridge. The latter is a psychophysiological fact in the minds or brains of certain real individuals, and has as satisfactory an empirical status as have the facts of mechanics. If all of these individuals were to be killed, there would certainly be no bridge-building purpose in any sense whatsoever, and the technology of bridge-building would become impossible.

Nevertheless, applied science does differ in a categorical manner from theoretical science. The latter purports only to formulate the facts of existence. Applied science, on the other hand, combines these facts logically with existing purposes and deduces the conditions for the maximal fulfillment of the latter. The conclusions of these deductions describe, not actual, but only possible, facts. They also describe possible lines of behavior through which the possible facts may be realized. It should be realized, however, that general theoretical scientific descriptions or laws are also descriptive of possible, as well as of actual, facts, and that the particular facts which are described in the conclusions of engineering reasoning are merely specific selections from among all of the possibilities in theoretical science, these selections being made on the basis of criteria set up by the operating purposes. The only excuse for the existence of theoretical science lies in the possibility of such application. The entire scheme of this science is so determined that it reveals to us what is possible on the basis of the observation of what is actual. It thus provides us with a basis for technological reasoning. In the absence of generalization such reasoning would be impossible. Technology is not a perversion of pure science but is rather its fulfillment.

232. *The Prior Problem of Complete Technology*

However, the proposal to practice complete technology in the control of human affairs is apparently blocked by the fact that we are ignorant of the nature of the *dominant desideratum.* It may even seem that we do not know whether or not there is such a thing at all. However, the concept can certainly be so formulated that there is no doubt regarding this latter point. The principles of motivation as we have presented them may be taken as a guarantee that all human action is governed by agencies which are of the nature of purposes. On the psychological side, these agencies are represented by the "desideratum images" which guide the course of the emotional or typical action experiences. In the development of such experiences, these desideratum images arrange themselves into hierarchies, in which one image represents the means to the fulfillment of another one. There is a corresponding hierarchy on the physiological side in the order of the conditioning of retroflexes,—as primary, secondary, tertiary, etc.

Now, any actual technological endeavor is an expression of these same facts and principles and can be traced back to motivational foundations which are at least *pen*ultimate. Suppose that we retrace the purposive system in this manner to a point where we can regress no further. We may then find a considerable *group* of determining factors, rather than a single variable such as is suggested by the term, dominant desideratum. It will still be possible, however, to combine all of the factors which are actually found, into a single mathematical function, and, hence, to represent them by a single quantity. Because of their actual quantitative interplay in controlling human response, they must be practically commensurate with each other and be amenable to representation by relative coefficients, weights or the like, so as to permit the construction of a general formula. This composite quantity may then be identified with the dominant desideratum. However, we are not justified in the present state of our knowledge in denying the existence of a really unitary purposive determinant underlying all human endeavor. In fact our theory of motivation has already demonstrated such a variable.

The question as to the identity of the dominant desideratum constitutes the *prior problem of complete technology*. This problem must be solved before technology can be possible as a perfected system of reasoning. The solution is to be looked for either in, or via, the psychophysiological theory of motivation, and the problem may be formulated technically as follows. Purposes are determiners of action. Out of many possible lines of action which are conceivably open to an individual in a given stimulus situation, purpose determines the choice of a single line which is selected with a view to the maximal realization of the purpose in question. Purposes may accordingly be said to govern choice among alternatives. The choice of lines of action is accompanied in consciousness by a selection of images, kinaesthetic and otherwise.

As we have previously suggested (see page 299) the psychological side of this process may be called *preference*, and involves the occupation of the focus of consciousness by one action image (or perception) to the exclusion of others. The alternative which is actually chosen may be said to be the most preferable one, or to possess the highest degree of *preferability* among all those which are available. However, if the originally preferred alternative were to be ruled out, some other alternative would be chosen; and if the latter in turn were excluded, still another would be taken. By continuing this process it would obviously be possible to determine the *order of preferability* of all of the alternatives which are presented by the situation. Each alternative could then have a definite number assigned to it which would determine its power to dominate consciousness under the given circumstances. Relative preferability values could be obtained by the "method of paired comparisons" in which every alternative is compared separately with each of the others, and the total number of times a particular alternative is preferred is taken as a measure of its preferability.

Such preferability values would evidently not be explanations, but only descriptions of the given system of choices. As such, they represent no theory but merely the plain facts about any case of human action, or the selection among alternatives. Now purposes, in a generalized sense, may be defined as *determinants of preferability:* a purpose is a *basis of preference.* Any adopted purpose, however, may itself be regarded as the product of a process of preference, since some different purpose might conceivably have been adopted. But, by the principle of the hierarchy of purposes, we explain the acceptance of the given purpose as an outcome of its successful subservience of some broader, already established, purpose. If we follow out this analysis, we may find, either that it leads through an interminable regression, or that it carries us back to some ultimate purpose or purposes which underlie all other proximate purposes; and have themselves no determinants. Concerning such ultimate purposes we can either say that they are not the results of an act of preference at all, because they always operate and have no possible alternatives; or else that there is no exception to the type of preference for which they stand. They possess universal and ultimate preferability, and all other preferabilities must be derivatives from them.

The function which complete technology is created to fulfill is that of producing the maximally preferable total human experience. In order to carry out this function we must discover the ultimate and most general determinants of all preferability, which will constitute the dominant desideratum, or the *ultimate basis of preference.* This is the prior problem of technology.

The solution of this problem has already been provided by our doctrine of the hedonism of the past, which states, in effect, that the preferability of any alternative line of response is proportional to the total amount of affection which has been experienced in connection with it during the entire lifetime of the individual, up to and including the present moment. The tendency of any given response to occur, and of the corresponding volitional choice to be made, is dependent upon the conductance of the corresponding cortical adjustor. Preferabilities thus stand in the same ranking order as adjustor conductances, but the latter are proportional to the affective integrals taken over the entire history of the given response mechanisms. Thus the dominant desideratum is the greatest possible value of $\int a\,dt$, or the greatest happiness.

It follows that the function of complete technology is to determine the forms of human conduct which will integrate the largest amounts of affection. There is no real paradox in the fact that technology must devote its attention to the future whereas the happiness, $\int a\,dt$, must be integrated into the past. The past, which is over and done, cannot be changed and is a subject-matter only for history. Controlling the amount of happiness in the past can only be accomplished by attention to the affectivity of the future, which is constantly passing over into the past. In order to summate any variable in time, it must move progressively into the past.

The instantaneous present, however, is the only concrete reality, and the principle of maximal integrated affection is only a demand that the affective intensity of the present consciousness should be maintained continuously at as high a value as possible. The magnitude of the happiness integral is an index of the success with which positive affectivity is maintained, regardless of the passage of time. In order to accomplish this maintenance, technology must direct its attention to the future, which merely means laying plans and making preparations for the control of affection. Such preparations, of course, cannot become effective until after they have been made.

Numerous questions arise in connection with this theory, and space does not permit us to consider them all in the present book. Undoubtedly the most important one is that as to *whose* happiness is to be considered. So far as our present analysis is concerned, it would appear that we have simply developed a technological formula for the individual. His preferences are determined by his own affections, and never directly by the affections of other persons. However, we may still claim to have established a general principle which holds for all individuals and, possibly, for all preferences whatsoever, and demonstrates the factual basis of preference in general. The question as to how we are to induce one individual to consider the happiness of another individual is not really involved in the general problem. It is perfectly clear that this can be done only by an application of the laws of motivation, of which the fundamental one is that his own affective processes are the sole determinants of his own behavior. Technology, however, is ordinarily a collective endeavor and represents a combination of the interests of a number of individuals, with a view to the advantage of each of them; and, hence, its plans will naturally apply to the happiness of all. One of the most important problems which technology has to face is that of eliminating the conditions which make it possible for one individual to profit hedonically by another individual's hedonic loss.

Chapter XXIX

Summary and Conclusion

Although the doctrine which has been presented in this book has developments and applications which may be indefinitely complex, the fundamental scheme has an essentially simple logical structure. It provides a few basic principles which are supposed to underlie all concrete cases of motivation. The logical development of these principles should permit us to explain all particular instances, after the analogy of mathematical or physical sciences. We may review the essentials of our doctrine as follows.

233. *Résumé*

The problem is divided, firstly, into physiological and purely psychological aspects, corresponding to the duality between the physical organism and consciousness, respectively. In harmony with established psychological views, we suppose consciousness to be "psychophysically correlated" with activities going on in a restricted area of the cerebral cortex, a portion of the brain. These activities are concerned with the "adjustment" of response, which involves the attachment of a particular form of motor reaction to a particular object or "stimulus" in the environment. The mechanism of such attachment involves the conduction of nervous excitation from the sense-organs through the cortex to the muscles, the kind of behavior which results being determined by the line of highest *conductance* among all alternative pathways.

We assume that heredity provides the individual with certain preformed paths of high conductance, but that these are confined, almost exclusively, to subcortical pathways. They furnish the foundations for so-called simple reflexes. We suppose that the cortex is congenitally without bias in its conductional characteristics, although such biased characteristics lie at the basis of all voluntary action. The fundamental problem is therefore that of determining the manner in which the conductional biases of the cortex are established. This is identical with the problem of *learning,* in the broadest sense of the latter term.

Our solution of the problem rests upon a physiological interpretation of the "pleasure-pain" senses. We note, firstly, that the "pleasure senses" are associated with conditions which are beneficial to the organism or species, whereas the "pain senses" are similarly related to injurious conditions. Accordingly, we designate them as *beneceptive* and *nociceptive,* respectively. In the second place, we observe that the excitation of beneceptors involves an augmentation of the conductances of any cortical pathways which may happen to be operative at about the same time. The stimulation of nociceptors, on the other hand, enforces a diminution of such conductances. These opposed processes are designated as forms of *retroflex action.* The conductance changes which result are supposed to be essentially permanent and cumulative, although not irreversible. There are other principles which may cause such conductance changes, including those of "use" and "disuse," and the direct action of chemical substances upon the cortical tissues.

The process of "learning by experience" is explained by these principles in the following manner. First, there must be a so-called *random* juxtaposition of a particular motor innervation, and a sensory excitation, as received by the cortex. However, it is random only in the sense that it is not determined by principles which guarantee its biological utility. The ensuing reaction may bring about the excitation of either beneceptive or nociceptive systems. In the former case the random juxtaposition will be "stamped in," or its conductance will be raised, whereas in the latter case the opposite effect will ensue. Habits, or specific responses, are established by the accumulation of such influences, so that for each familiar stimulus there is a preferred pathway to the muscles,—which determines a particular form of motor reaction.

We now bring in the well-known principle that innate forms of sensibility, such as reflexes and retroflexes, can be *conditioned*. This means that a single association of the congenitally effective stimulus with a different stimulus may render the latter capable of arousing the sensibility in question. In the case of the retroflexes, this enables them to be turned over to the control of any stimulus whatsoever, so that the latter may acquire the power to raise or lower cortical conductances. Such a transfer of power from one stimulus to another may occur in a series of steps having any required degree of complexity. The various retroflexes —of which there are more than twenty—may be grouped as a consequence of experience into conditioned organizations and hierarchies having many possible varieties of structure. Such *sentiments and complexes* furnish the agencies which underlie the more advanced processes of learning. So-called *instincts* are explained in terms of systems of this sort, although primitive *appetitions* may be regarded as resting upon the action of primary retroflexes, particularly nociceptive ones.

In order to establish a relationship between these physiological processes and consciousness, we assume that *affectivity,* or the degree of pleasantness-unpleasantness, is proportional, at all times, to the rate of change of conductances in that portion of the cortical process which underlies consciousness. Pleasantness accompanies an increasing conductance, whereas unpleasantness goes with the process of decrease. Accordingly, affectivity will be correlated with retroflex action, whether primary or conditioned; but also with the operation of the principles of use and disuse, or any other agency which may modify conductances. The affective aspects of sensation, perception, emotion, and other psychological activities are adequately explained on the basis of these assumptions. The principle of use accounts for the so-called pleasures of *novelty,* whereas that of disuse enables us to explain *ennui* and certain difficulties which are encountered in the application of the principle of use, by itself. In this way, affectivity is made to appear as the key to motivation on the purely psychological side.

The resulting doctrine comprises a form of *psychological hedonism,* according to which voluntary choices are determined by the summation of all past affections. Each possible form of response to a given stimulus is characterized by a particular value of this summation, and the alternative which has the highest value will always be chosen above others. In other words, the integral of past affective experience, which is our interpretation of the word, *happiness,* constitutes the basis of *preferability,* among alternatives. This form of "hedonism of the past" is consistent not only with the foundations of hedonism in general, but, also, with the facts which have previously been presented in refutation of hedonistic doctrines. It also furnishes us with a basis for what we have called *complete technology,* as a "substitute for ethics."

The specific applications of these principles, as discussed in considerable detail in the body of this book, include the following: the nature and dynamics of many typical emotional experiences, the nature and operation of purposes, the types and characteristics of complexes, especially the structure and effects of the all-important "ego complex," the characteristics of sexual motivation, and the conflict of motives. We have also dealt with a large number of common motivational processes, including those which are involved in typical modern interests, such as in automobiles, music, the drama, radio, etc. The application of our principles to the analysis of *personality* has been considered in some detail; and we have concluded with an outline of the basis and program of "complete technology."

234. *Philosophical Considerations*

There may be some philosophically-minded readers who will remain dissatisfied by the dualistic treatment which is characteristic of our discussion, according to which mind and body are regarded as two entire separate systems exhibiting only a formal correlation. For the benefit of such readers, we may suggest what seems to the writer to be the most satisfactory resolution of this dualism.

Consciousness and matter are not in reality two separate systems, but are only conceived as such. The fundamentally real system is that of consciousness or experience, alone. The physical scheme is a conceptual development which arises, so to speak, from viewing the psychical system from the outside. When one man studies another man's psychical organism by the methods of physiological or physical science, he arrives at a so-called physical account, although the reality which is actually determining this account is simply the psychical system, itself. The physical scheme as a whole is to be regarded as symbolic, conceptual development of this sort, which actually stands for purely psychical reality.

This means that receptors, nerve conductors, the retroflex mechanisms, the cortical synergy, and other physiological ideas, are not depictions of actuality. They are surrogate or duplicate accounts of a psychical system which is more truly described by the terminology of introspective psychology. Unfortunately, however, the methods of introspection do not permit us to examine the entire psychical system. They are restricted to that portion of it which corresponds to the dominant cortical synergy. In the case of the latter, however, we are able to develop both the physical and the introspective descriptions, so that a logical dualism or parallelism results. The parallelism of the two accounts in this particular case should provide us with the general key to the understanding of the entire psychical organism, which must be conceived to be vastly greater than that which is accessible to introspection. By means of this key—which consists in the fundamental psychophysical laws—we should be able to translate any physical description whatsoever into the corresponding, and true, psychical account. This is the essence of the theory known as *psychical* *monism,* which has been independently advocated by W. K. Clifford,[215] Morton Prince,[216] C. A. Strong,[217] G. Heymanns,[218] and the present writer.[219]

If we accept this doctrine, we can say that psychical agencies, such as sensations, perceptions, ideas, purposes and affections, are causally effective in a full sense. They stand in the same relation to the general psychical organism and universe as do the corresponding factors in the cortical synergy to the physical organism and universe. Sensations and perceptions are real effects of objective forces, and purposes and other affect-laden mental contents are true causes of reaction. The real reactions, however, are not physiological or motor, but objective in the psychical sense. The apparent physical effects are the perceptual or conceptual mental representations of these objective changes.

Of course, the full development of the psychical monistic view cannot be attempted in the present book. However, it provides us not only with a resolution of the psychophysical dualism, but with a method for metaphysical research. In fact, it should lead us to the fundamental goal of theoretical science, namely an adequate description of ultimate reality. At the present point, we may indicate only one probable outcome of such investigations. This lies in the principle that in the psychical world as a whole all changes are governed by an affective law, analogous to that of our "hedonism of the past." Affection, in other words, is the determinant of dynamics in the panpsychic universe. Everything which happens is governed by the principle of the choice of the pleasantest possible alternative, and all existing structures and motions are representations of affective history, possessing stability and momentum in proportion to the magnitudes of the corresponding affective time integrals.

This general principle of the affective law may enable us to carry the investigation of the "prior problem of technology" beyond the history of the individual, and to show that his hereditary predispositions are also determined by an affective integral. In this case, happiness would appear to be the dominant desideratum of all structures and changes whatsoever, being the principle whereby all psychical evolution is motivated. This might provide a definite mode of escape from hedonistic individualism, since the individual is a temporary creation of the psychical system at large, and is only one stage in the hierarchy of its affectively determined purposes or desires.

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GLOSSARY

The following list provides definitions and explanations of some of the more difficult terms used in this book.

ADJUSTOR.—A nerve center arrangement by the operation of which certain incoming nerve currents are enabled to set off specific outgoing currents. In the majority of cases considered in this book, the adjustor is located in the cerebral cortex, and links a certain pattern of sensory excitation with particular postures or movements of the voluntary muscles.

AFFECTION.—A general term for pleasantness or unpleasantness, considered as phenomena in consciousness. Affection is a more abstract conception than *feeling*, which includes the sensory or perceptual features of the consciousness.

AFFECTIVE INTENSITY.—The measure of the degree of pleasantness or unpleasantness of consciousness at any moment. It is an algebraic quantity or variable, having positive values to represent degrees of pleasantness, and negative ones to stand for degrees of unpleasantness. A zero value indicates a state of affective indifference.

AFFERENT.—An adjective, indicating nerve paths or processes leading from sense-organs to nerve centers. Contrasted with *efferent*.

APPETITION.—A process of physiological unrest, involving trial and error behavior, and ordinarily set off by the excitation of a nociceptive, or negative retroflex, process. The physiological counterpart of desire or aversion.

BENECEPTION.—A process in a sense-organ or afferent nerve channel which is indicative of conditions or events that are typically beneficial to the individual or species.

CHRONAXY.—A measure of the rate at which a standardized stimulus must be applied to a nerve or a muscle in order just to excite. It is indicative of the speed of response of the given tissue.

COMPLEX.—A combination of affective tendencies with otherwise neutral ideas or perceptions. If only one such tendency is involved, it is preferable to call the compound a *sentiment*. On the physiological side, a complex consists in a combination of conditioned retroflexes. Complexes are products of individual life-histories, or are nonhereditary in origin.

Conditioned.—An adjective, applying to reflexes and retroflexes, indicating that the stimuli which arouse them have been determined by the individual life-history rather than by heredity.

Conductance.—The property of conductors which enables them to conduct. Specifically, in our discussion, the measure of the tendency of an adjustor to be set off by its adequate stimulus or the appropriate afferent nerve currents. The tendency of a particular form of response to occur when the proper stimulus is given.

Consciousness.—The total field of experience which is open to observation by any given individual at any moment. The Given, or that which is accessible to introspective report. It is essentially a mosaic of qualitative phenomena and not a relation between a subject and objects. Contrasted with the *subconscious*, which is conceived to be a somewhat similar system not accessible to introspection, and with the *physical* organism.

Correlation.—The relation between two factors or variables which consists in a definite correspondence between their values without regard to the cause of such correspondence. One factor can be represented as a mathematical function of the other, although not necessarily with perfect reliability.

Cortex.—Ordinarily used to designate the highest and most complex adjustor centers of the brain, forming the major part of the cerebrum. The principal organ for learning and the seat of the "region of determination of consciousness," in human beings.

Effector.—An organ which receives the efferent nerve currents and is actuated by them to yield a *reaction* and thus to produce an effect upon the organism or the environment Ordinarily, it is a muscle or group of muscles, but it may be a gland or an electrical organ in certain cases.

Efferent.—An adjective, indicating nerve paths or processes leading from nerve centers, or adjustors, to effectors. Ordinarily, the latter are muscles or muscular systems.

Entegration.—A new term, introduced in this book to designate the process by which concomitant afferent processes are combined or "integrated," on the sensory side of the cortex. This process is presumably located in the sensory projection and association areas of the latter.

Experience.—The sum of all of the actual phenomena which are given to any individual, not only simultaneously, but over any specified span of time. It is characterized by being private to the individual in question and by being contrasted with the inferred system of physical things. The "individual" is not conceived as a soul or subject, but merely as a particular, continuing, system of observations or introspective reports.

Facilitation.—A process by which a given process of response, or nervous conduction, is increased or encouraged. Usually, in the discussions of this book, facilitation is supposed to be due to an increase in the conductance of the adjustor which is involved in the response.

Hedonism.—The doctrine that action choices or preferences are determined in some manner by "pleasure and pain" (or affection), so as to favor the former and oppose the latter.

Incitation.—A term which is used technically in this book to stand for the processes on the efferent side of the cortex which regulate the manner of innervation of the motor or efferent conducting fibres. It may also be applied to similar processes in lower nerve centers. It corresponds with *entegration* on the afferent side. The related adjective is "incito-motor." (as used by H. Piéron.)

Inhibition.—An influence by which a given process of response, or nervous conduction, is decreased or discouraged. Usually, in the discussions of this book, inhibition is supposed to be due to a decrease in the conductance of the adjustor which is involved in the response.

Introspective.—Pertaining to the process in which direct reports or descriptions are made of the nature, constitution or processes of consciousness or experience. Also used to characterize the facts so reported or accessible to such report.

Kinaesthetic.—An adjective characterizing those portions of experience which are determined by afferent nerve impulses in the proprioceptive system. Images or direct sensations of bodily posture or movement.

Neurogram.—A record supposed to be impressed upon the cortex by any pattern of afferent nerve currents arriving at that organ. Each neurogram is specific to the kind and form of the currents in question, and may be rearoused centrally to yield a consciousness similar to that which accompanied them originally, although usually of lower subjective intensity (an image).

Neutroception.—Any kind of sensory process which is neither beneceptive nor nociceptive.

Nociception.—A process in a sense-organ or afferent nerve channel which is indicative of conditions or events which are typically injurious to the individual or species.

Physical.—An adjective used to characterize the nature of the universe (and man) as conceived by the modern physicist. This conception is exclusively in terms of space, time, and electromagnetic units, particularly electrons and protons. The physical system is supposed not to be given in experience, but to be inferred from it.

Proprioceptive.—An adjective, used to designate the afferent nerves and processes which arise in the effector system of the body and in the vestibular apparatus of the inner ear. These nerve currents are indicative of the given posture or movement of the organism.

PSYCHICAL.—Having the general nature of consciousness or experience, as opposed to the physical.

PSYCHOPHYSIOLOGICAL.—Concerned with the determinative relationships between individual experience and the processes of the corresponding individual organism, the latter being conceived physically.

THALAMUS.—A portion of the brain, forming the vestibule to the cerebral cortex, through which nearly all afferent nerve currents pass on the way to the latter. It contains special nerve centers for impulses derived from the receptors for "pain."

THRESHOLD.—The smallest perceptible amount, whether of absolute magnitude or of difference in magnitude. Physiologically, the lowest value of a stimulus which will set off any response.

REACTION.—Used in this book to stand for the effector processes in response. A unit of behavior.

RECEPTOR.—Any sensory cell which serves to pick up a physical stimulus and transmit its influence to an afferent nerve, so as to set up currents in the latter.

REDINTEGRATION.—The process or condition whereby components of consciousness or experience are combined to form coherent patterns: perceptions or ideas. The modern equivalent of the phrase: "the association of ideas," and the psychical counterpart of *entegration*.

REFLEX.—A specific and relatively simple response mechanism and its process, laid down exclusively by hereditary forces.

RESPONSE.—The process which consists in the stimulation of a receptor, followed by afferent conduction, specific central adjustment, efferent conduction, and a corresponding reaction. The term may also be used to refer to the mechanism underlying this process. Response may be of any degree of simplicity or complexity and may be either hereditary or acquired.

RESPONSE SPECIFICITY.—The particular concatenation of stimulus and reaction which characterizes any given response.

RETROFLEX ACTION.—The process whereby stimulation of beneceptive or nociceptive mechanisms facilitates or inhibits concurrent cortically adjusted responses. The physiological mechanism of the pleasure-pain senses.

STIMULUS.—The physical force or energy which excites any given receptor.

SUBCONSCIOUS.—A hypothetical field of psychical components and processes, which is supposed to be attached to the conscious field but is not accessible to introspection.

SYNAPSE.—The junction point between two nerve conductors. A place of transfer of excitation from one nerve cell to another.

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