PSYCHOLOGY

AN INTRODUCTORY STUDY OF THE STRUCTURE AND FUNCTION OF HUMAN CONSCIOUSNESS

BY

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PREFACE TO THE FIRST EDITION

PSYCHOLOGISTS have hitherto devoted the larger part of their energy to investigating the *structure* of the mind. Of late, however, there has been manifest a disposition to deal more fully with its functional and genetic phases. To determine how consciousness develops and how it operates is felt to be quite as important as the discovery of its constituent elements. This book attempts to set forth in an elementary way the generally accepted facts and principles bearing upon these adjacent fields of psychological inquiry, so far as they pertain to the mind of man.

Inasmuch as it is mental activity, rather than mental structure, which has immediate significance for thought and conduct, it is hoped that students of philosophy, as well as students of education, may find the book especially useful. The author has had the interests of such students constantly in mind.

The differing conditions under which introductory courses in psychology are offered at various institutions render it desirable that a text-book should be adaptable to more than one set of circumstances. The present text has accordingly been arranged with the purpose of permitting considerable flexibility in the emphasis laid upon the several portions of the subject. This fact accounts for an amount of repetition and cross-reference which otherwise would have been regarded as unnecessary.

To my teachers, Professor John Dewey and Professor William James, I owe much of what may be found good in these pages. Were not the list too long to recount, I should gladly express my obligations to the many other psychologists by whom I have been influenced in the formation of my views.

I am much indebted for advice and suggestion to a number of my colleagues in the University of Chicago, especially to Professor H. H. Donaldson, Professor A. W. Moore, and Dr. J. B Watson. My wife has given me great assistance in the preparation of my manuscript.

For the use of a number of illustrations acknowledgments are due to the following authors and publishers: William James; D. Appleton & Co., publishers of Barker's "The Nervous System"; W. B. Saunders & Co., publishers of "The American Text-Book of Physiology"; Walter Scott, Ltd., publishers of Donaldson's "Growth of the Brain"; John Murray, publisher of McKendrick and Snodgrass' "Physiology of the Sense Organs"; and G. P. Putnam's Sons, publishers of Loeb's "Physiology of the Brain."

J. R. A.

University of Chicago,
November, 1904.

PREFACE TO THE FOURTH EDITION

The present edition contains a large amount of new material, chiefly empirical in character. To offset this addition, many of the more strictly theoretical discussions have been condensed. Most of the new matter is so introduced that it may be omitted if necessary without seriously impairing the exposition of general principles and theory. The old material has been re-arranged, many new drawings have been supplied, the paragraph headings have been elaborated, a list of collateral reading has been added at the close of the text, and at every point an earnest effort has been made to secure greater lucidity.

Although there are occasional changes in the form of expression, there are no conscious alterations of the fundamental principles formulated in the earlier editions. For example, the presentations of imagery and volition have been somewhat modified in the interests of cogency, but the essential doctrines remain.

After careful consideration I have refrained from adding a set of practical exercises for students, despite many requests for such material. I am convinced that a competent teacher can with advantage devise a group appropriate to his own peculiar needs. If time be lacking for arranging such a set, there are now available several good store-houses from which supplies can be drawn, not to mention the special manuals which are beginning to appear to meet just this need.

It is a pleasure to acknowledge my obligation to many teachers in all parts of the country, to whose appreciative and intelligent criticism is due no small number of the alterations incorporated in this edition. The real merits and defects of a text-book can only be adequately recognized in the actual stress of class-room use. I am therefore particularly grateful for the suggestions made by instructors working under conditions somewhat different from those out of which this book originally grew.

To my colleague, Dr. John B. Watson, to Professor Henry H. Donaldson of the Wistar Institute, and to Professor Arthur H. Pierce of Smith College, I am under an especial debt of gratitude for wise advice and helpful criticism.

Acknowledgments are also due to the following authors and publishers for their kind permission to make use of illustrations from their works: Professor W. H. Howell and W. B. Saunders & Co., publishers of his "Text-Book of Physiology"; Professors T. Hough and W. T. Sedgwick, and Ginn & Co., publishers of their "Elements of Physiology."

J. R. A.

UNIVERSITY OF CHICAGO,
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PSYCHOLOGY

CHAPTER I

PROBLEMS AND METHODS OF PSYCHOLOGY

Definition of Psychology.—Psychology is commonly defined as the science of consciousness. It is the business of a science systematically to describe and explain the phenomena with which it is engaged. Chemistry, physics, and the various branches of biology all attempt to deal in this manner with some special portion of the facts or processes of nature. Mental facts, or facts of consciousness, constitute the field of psychology.

The Nature of Consciousness.—*Consciousness* we can only define in terms of itself. Sensations, ideas, pains, pleasures, acts of memory, imagination, and will—these may serve to illustrate the experiences we mean to indicate by the term; and our best endeavour to construct a successful definition results in some such list, of which we can only say: "These taken together are what I mean by consciousness." A psychological treatise is really an attempt to furnish the essentials for such a catalogue.

It is generally maintained that despite our difficulty in framing a satisfactory definition of consciousness, we can at least detect one or two of its radical differences from the physical objects which make up the rest of our cosmos.

These latter always possess position and extension, *i. e.,* they occupy space. Psychical facts, or events, never do; on the other hand they possess one characteristic which, so far as we know, is wholly wanting to physical facts, in that they *exist for themselves.* A man not only has sensations and ideas, he *knows* that he has them. A stone or other physical object has no such knowledge of its own existence or of its own experiences. Yet, whatever may be the value of these distinctions, we need entertain no real fear of encountering any serious misapprehension of the inner nature of consciousness, for each one of us experiences it every day for himself and each is thus fitted to discuss it with some measure of accuracy.

Former Definitions of Psychology.—Formerly psychology was often defined as the science of the soul. But the word *soul* generally implies something above and beyond the thoughts and feelings of which we are immediately conscious; and as it is these latter phenomena with which psychology is primarily engaged, this definition is now rarely used by careful writers. Psychology is also defined at times as the science of mind. The objection to this definition is that the word *mind* ordinarily implies a certain continuity, unity, and personality, which is, indeed, characteristic of normal human beings; but which may, for all we can see, be wholly lacking in certain unusual psychical experiences like those of insanity, or those of dream states, and may be wanting at times in animals. All consciousness everywhere, normal or abnormal, human or animal, is the subject matter which the psychologist attempts to describe and explain; and no definition of his science is wholly acceptable which designates more or less than just this. Nevertheless, we shall often employ the term mind in this book, using it to designate the entirety of the intelligent processes which occur in the organism.

The Procedure of the Psychologist.—In his description of conscious processes the psychologist attempts to point out the characteristic features of each distinguishable group of facts and of each member of such groups, and to show how they differ from one another. Thus, for example, the general group known as "sensations" would be described and marked off from the group known as "ideas"; and the peculiarities of each form of sensation, such as the visual and tactile forms, would be described and distinguished from one another and from those belonging to the auditory form. The psychologist's explanations consist chiefly in showing (1) how complex psychical conditions are made up of simpler ones, (2) how the various psychical groups which he has analysed grow and develop, and finally (3a) how these various conscious processes are connected with physiological activities, and (3b) with objects or events in the social and physical world constituting the environment.

The Fields of Psychology.—In this book, which is devoted primarily to *general psychology,* we shall be mainly concerned with the facts and principles of normal human consciousness, its constitution, its modes of operation, and its development. But we shall avail ourselves, wherever feasible, of useful material from various allied fields, such as child psychology, abnormal psychology, and animal psychology.

Child psychology is occupied with the study of the mental processes of infants and young children, with special reference to the facts of growth.

Abnormal psychology has to do (1) with the study of the unusual phases of conscious process, such as are met with in trance, hallucinations, hypnotism, etc.; and is concerned (2) with the more definitely diseased forms of mentality, such as characterise insanity.

Individual psychology: As is well known, individuals vary from one another in many ways as regards the precise texture of their minds. For example, certain persons have good memories for visual experiences, others for auditory. Certain people enjoy music, to others it is an affliction. Many persons are stolid in temperament, whereas others are highly excitable. The study of such personal traits as these is called *individual psychology*. The term *variational psychology* is often employed to cover not only investigation of these purely individualistic differences, but also the study of racial and other group peculiarities such as are revealed in social psychology and folk psychology. Within this field of variational psychology would fall the study of genius, of the criminal, of sex differences, of mental types and temperaments. Almost all the great fields of human interest and experience are now studied from the side of psychology and we hear accordingly of religious psychology, of the psychology of art, of educational psychology, and so forth.

Social psychology, in its broadest sense, has to do mainly with the psychological principles involved in those expressions of mental life which take form in social relations, organizations, and practices, *e. g.*, the mental attributes of crowds and mobs as contrasted with the mental characteristics of the individuals constituting them. A branch of social psychology, often known as *folk psychology*, or race psychology, is concerned with the psychical attributes of peoples, especially those of primitive groups as contrasted with civilised nations. The development of language affords one of the interesting problems in this field.

Animal psychology, frequently called comparative psychology, is engaged with the study of consciousness, wherever, apart from man, its presence can be detected throughout the range of animal life. The term comparative psychology is also applied more broadly though more accurately to those branches of psychology, such as child psychology, abnormal psychology, social and race psychology, as well as animal psychology, in which the phenomena studied are compared with other ranges of mental activity, especially with the psychical processes of normal adult human life. Those phases of psychology which touch particularly upon the phenomena of development, whether racial or individual, are usually designated *genetic psychology.*

The Methods of Psychology.—(1) Introspection.—The fundamental psychological method is introspection. Introspection means looking inward, as its derivation indicates. As a psychological method it consists simply in the direct examination of one's own mental processes. Much mystery has been attached to the fact that the mind can thus stand off and observe its own operations, and criticism has been lavishly devoted to proving the impossibility of securing scientific knowledge in any such fashion as this. But it is an undeniable fact that by means of memory we are made aware of our mental acts, and we can trace in this manner by careful and systematic observation many of the rudimentary facts and principles peculiar to human consciousness. When a number of us coöperate in such introspective observation, we greatly augment the exactness and the breadth of our results, and the accepted doctrines of psychology have actually been established by the successive observations of many investigators in much this manner.

(2) Objective Observation.—Moreover, we are able to supplement introspection by immediate objective observation of other individuals. It is thus possible, for example, to detect much which is most characteristic of the emotions, such as anger and fear, by watching the actions of persons about us and noting their expressions, their gestures, etc. The facts which we thus obtain must of course be interpreted in terms of our direct knowledge of our own experience, gained introspectively. But such observation of others often makes us sensitive to psychological processes in ourselves, which we should otherwise overlook. Finally, it is clear that our psychological facts, whether gained from observation of ourselves, or of others, must be made the subject of careful reflection and systematic arrangement before they can become of scientific value: otherwise they would be purely haphazard, disconnected fragments, with no more meaning than any other collection of odds and ends. The need of such orderly reasoned arrangement is no more and no less true of the psychological facts gained by observations of others, or by introspection, than it is of physical facts discovered in any realm of science. The facts of gravity had been noticed again and again, but it required the ordering mind of a Newton to set them in intelligent array. Whenever we speak of objective observation, or of introspection, as methods, we shall understand, therefore, this systematic and scientific implication of the terms. The remaining psychological methods which we shall mention are simply developments of these two in the direction of systematising, perfecting and extending their employment.

(3) **Experiment.**—Experimental psychology, sometimes spoken of as "the new psychology," or the "laboratory psychology," is perhaps the most vigorous and characteristic psychological method of the present day. It is simply an ingenious system for bringing introspection and observation under control, so that their results can be verified by different observers, just as the result of a chemical experiment may be verified by anyone who will repeat the conditions. In every branch of science an experiment consists in making observations of phenomena under conditions of control, so that one may know just what factors are at work in producing the results observed. A psychological experiment is based on precisely the same principle.

The larger part of the psychological investigation conducted by means of these several methods has thus far been devoted to the *qualitative* analysis of consciousness. In recent years, however, the development of experimental procedure has stimulated an increasing interest in the study of the *quantitative* aspects of mental process. Because of this fact a sharp distinction is occasionally made nowadays between qualitative and quantitative psychology.

(4) Physiological Psychology and (5) Psychophysics.—Physiological psychology and psychophysics, which are both closely connected, in spirit and in fact, with experimental psychology, are especially devoted to investigating the relations between consciousness on the one hand, and the nervous system and the physical world on the other. Much of physiological psychology, and all of psychophysics, is experimental so far as concerns the methods employed. They both furnish information supplementary to that gathered by ordinary introspection and observation.

Psychophysics forms a part of the larger field of quantitative psychology to which reference has just been made. Its aim is to reduce to quantitative formulæ the relations of conscious processes to the physical world. For instance, it attempts to determine the exact physical changes in the intensity of light necessary to produce noticeable changes in the sensations which light occasions. Physiological psychology on the other hand is devoted primarily to determining the correlation between the activities of the body, particularly of the nervous system, and the various forms of conscious process, such, for example, as vision and hearing. We shall make frequent use of material drawn from this source.

Relations between the Various Methods and Fields of Psychology.—Evidently certain of these methods are applicable to more than one field of psychological investigation. Observation is valid everywhere. Experiment can be employed with children, with adults and with animals. Introspection is available with normal adults and can often be used with children. Many abnormal conditions permit its use. Other inter-relations will readily suggest themselves.

The Psychologist's Standpoint.—In our study of mental processes we shall adopt the biological point of view just now dominant in psychology, and regard consciousness, not as a metaphysical entity to be investigated apart from other things, but rather as one among many manifestations of organic life, to be understood properly only when regarded in connection with life phenomena. We shall discover, as we go on, abundant reason for the belief that conscious processes and certain nervous processes are indissolubly bound up with one another in the human being. But at this point, without attempting to justify the assertion, we may lay it down as a basal postulate that the real human organism is a psychophysical organism, and that the mental portion of it is not to be completely or correctly apprehended without reference to the physiological portion. The psychophysical organism is, moreover, a real unit. The separation of the mind from the body which we commonly make in thinking about them is a separation made in behalf of some one of our theoretical or practical interests, and as such, the separation is often serviceable. In actual life experience, however, the two things are never separated. Therefore, although our primary task is to analyse and explain mental facts, we shall attempt to do this in closest possible connection with their accompanying physiological processes.

Our adoption of the biological point of view, while it implies no disrespect for metaphysics, will mean not only that we shall study consciousness in connection with physiological processes wherever possible, but it will also mean that we shall regard all the operations of consciousness—all our sensations, all our emotions, and all our acts of will—as so many expressions of organic adaptations to our environments, an environment which we must remember is social as well as physical. An organism represents, among other things, a device for executing movements in response to the stimulations and demands of the environment. In the main these movements are of an organically beneficial character, otherwise the creature would perish. Mind seems to involve the master devices through which these adaptive operations of organic life may be made most perfect. We shall consequently attempt to see how the various features of consciousness are concerned in this adaptive process. Let it not be supposed that such a point of view will render us oblivious of, or insensitive to, the higher and more spiritual implications of consciousness. On the contrary, we shall learn to see these higher implications with their complete background, rather than in detachment and isolation.

Psychology and Natural Science.—In one important particular the method of psychology follows the procedure of the natural sciences, such as physics, botany, and geology. Psychology takes for itself a certain definite domain, *i. e.*, consciousness as a life process. Moreover, it starts out with certain assumptions, or postulates, as they are called, about its subject matter, which it refuses to challenge. The chemist, for example, never stops to inquire whether matter really exists or is simply an illusion. He assumes its reality without question, and forthwith goes about his business. So the psychologist assumes in a common-sense way the reality of mind and the reality of matter. Nor does he question that mind can know matter. These assumptions prevent the necessity of his untangling the metaphysical puzzles which are involved at these points, and leave him free to investigate his field in a purely empirical way. He also attempts, wherever possible, to emulate the natural scientist's use of the idea of causation. Our most reliable forms of knowledge about nature are based upon our knowledge of cause and effect relations. A great deal of our chemical knowledge is in this way exceedingly precise and exact; whereas the lack of such knowledge renders much of our acquaintance with disease extremely superficial and unreliable.

The subject matter of psychology evidently brings it into a distinctly universal relation to all the other sciences, for these sciences are severally engaged in the development of knowledge, and the knowledge-process is itself one of the subjects in which psychology is most interested.

Psychology and Biology.—Inasmuch as psychology is occupied with life phenomena, it is clearly most nearly related to the biological sciences. Indeed, as a natural science it obviously belongs to the biological group. This relationship is as close in fact as it is in theory. The modern psychologist makes frequent use of material furnished him by the anatomist, the physiologist, the zoölogist, and the alienist, and he gives them in return, when he can, such psychological facts as they find it necessary to employ.

Psychology and Philosophy.—Psychology has developed historically out of philosophy, and although it is now in many ways practically independent, its relations with philosophy are necessarily very intimate. The connection is particularly close with those branches of philosophy commonly called normative, *i. e.*, ethics, logic, and æsthetics. These inquiries are respectively concerned with questions of right and wrong, truth and error, beauty and ugliness. It is evident that the profitable discussion of such problems must involve a knowledge of the mental operations employed when we make a right or wrong choice, when we reason falsely or truly, when we experience pleasure in listening to music, etc. In a sense, therefore, psychology furnishes the indispensable introduction to these several philosophical disciplines. It affords an acquaintance with the mental processes which lead respectively to conduct, to knowledge, and to the creation and appreciation of art. It thus enables an intelligent apprehension of the problems which arise in these spheres, and furnishes much of the material essential for their solution. A similar thing is true, though in a less conspicuous and obvious way, of the relation of psychology to metaphysics, and to that form of metaphysical inquiry which formerly was known as rational psychology.

By rational psychology was commonly understood the inquiry into the conditions rendering the existence of consciousness possible. Evidently these inquiries, *i. e.*, rational psychology and metaphysics, together with what is known as epistemology, or the theory of knowledge, are engaged with just such problems as underlie the assumptions of psychology and the natural sciences, *e. g.*, the reality of matter, its independence of mind, etc. It is on this account that metaphysics is said to be the science of sciences. It attempts to apprehend the essence of reality, to solve the problem of the ultimate nature of mind and matter and their relations to one another. Although metaphysics is in this sense more fundamental than psychology, and logically antecedent to it, it is so extensively concerned with mental processes, that a knowledge of psychology is commonly recognised as practically indispensable for its effective conduct or apprehension. All these branches of philosophy clearly involve, as does psychology, the study of consciousness in a certain sense. But whereas these distinctly philosophical disciplines are primarily interested in some one or another of the *implications* and *products* of thought processes, psychology is interested primarily in the constitution and operation of consciousness itself. We may question whether ultimately there are any hard and fast lines severing these philosophical inquiries from one another and from psychology. The distinctions are perhaps rather practical than ultimate. One inquiry inevitably shades off into the others.

Psychology and Education.—Psychology is related to educational theory in much the way that it is to ethics. It may be said to be related to actual educational procedure as theory is to practice. Education has as its function the symmetrical development of the powers of the individual. What the natural relations may be among these faculties, what are the laws of their unfolding, what the judicious methods for their cultivation or repression—these and a thousand similar practical questions can be answered by the assistance of psychological observation, or else not at all. The result which we desire to attain in our educational system must be, in a considerable measure, determined by the social and ethical ideals we have in view. But the securing of the results, the realising of the ideals which we have set up, through our educational machinery—this must be accomplished, if we would work with true insight and not by blind experiment, through a real knowledge of human mental processes. We shall keep constantly before us in this book the facts of growth and the facts of adaptation to the demands of the environment. Clearly these are the facts of practical significance for educational procedure.

CHAPTER II

THE PSYCHOPHYSICAL ORGANISM AND THE NERVOUS SYSTEM

The Union of the Psychical and the Physical in the Organism.—We shall now examine some of the evidence confirmatory of our assertion in the last chapter, that conscious processes and physiological processes are intimately connected in the organism. We shall in this way discover some of the reasons why it is desirable for us at the outset of our study of mental life to learn something about the nervous system, to which subject we shall then devote the remaining portion of the chapter.

Evidence from Familiar Facts.—Common observation informs us of at least two fundamental types of fact concerning these mind-body relations. We know in this manner (1) that our consciousness or knowledge of the world about us depends primarily upon the use of our senses. A person born blind and deaf has neither visual nor auditory sensations or ideas, and never can have, so long as he remains destitute of eyes and ears. By means of the other senses he may be taught much about colours and sounds, as Helen Keller has been, who lost her sight and hearing in infancy; but he never can have the experience which you or I have, when we see a colour or hear a sound, or when we permit a melody "to run through our heads," as we say, or when we call into our minds the appearance of a friend's face. Indeed, if a child becomes blind before he is five years old he commonly loses all his visual ideas and memories just as completely as though he had been born blind. There is every reason to believe that if we were deprived of all our senses from birth, we could never possess knowledge of any kind. The senses thus hold the keys which unlock the doors of intelligence to the mind, and the senses are physical, not mental, things. Apparently, therefore, the most simple and fundamental operations of consciousness are bound up with the existence and activity of certain bodily organs.

Common observation also informs us (2) that the *expressions* of mind ordinarily take the form of muscular movements which we call acts. We hear a bell and our consciousness of the sound results in our going to open the door. We consider a course of action, and the outcome of our deliberation issues in the form of words or deeds, all of which consist primarily in muscular movements. Strange as it may appear, even keeping still involves muscular activity. It would accordingly seem as though the mind were hemmed in between the sense organs on the one hand and the muscles on the other. It would be a truer expression of the facts, however, to say that these are the tools with which the mind works. Through the sense organs it receives its raw material, and by its own operations this material is worked up and organised into the coherent product which we call intelligence. This intelligence is then made effective in practical ways through the rationally controlled action of the voluntary muscles.

There are other facts of a well-known kind whose precise purport is, perhaps, less evident, but whose general implication of intimate connections between mind and body is identical with that of the considerations which we have just mentioned. We know, for example, that blows and wounds may seriously disturb consciousness, or even destroy it. The similar effects of many drugs, such as alcohol, ether, and hashish, are matters of common knowledge. Even coffee and tea exercise a mild influence upon our psychical mood, and the change in general disposition which frequently follows indulgence in a satisfactory meal is a phenomenon familiar to every family circle. Bodily disease often produces a most marked effect upon the mind, and conversely the different effect upon certain diseases, of a cheerful or a depressed mental attitude, is a subject of frequent remark.

Evidence from Scientific Facts.—When we examine the less familiar evidence offered us by certain branches of modern science, we find our previous impressions strongly confirmed. Thus we learn from pathology, the science of disease, that disordered conditions of particular portions of the brain tissue are accompanied by disturbances of definite kinds in consciousness. In this way we learn, for example, that the destruction or disintegration of the tissue of one region in the brain is followed by the loss of one's visual memories, so that one cannot recall the appearance of familiar objects. A similar disorder in another region costs one the control of certain muscles in the hand, etc. The science of anatomy is able to demonstrate structural connections of nerves between these diseased parts of the brain and the sense organs and muscles over which consciousness has lost control, thus supporting the implication of the pathological evidence already cited. Experimental physiology shows us, that by stimulating (either mechanically or electrically) certain brain areas in animals, we can produce movements of definite muscles, whereas by extirpating these regions we can at least temporarily cripple the muscles and render the will powerless over them. By similar excisions of other brain areas we can cripple definite sense organs. Muscular movements are also elicited by stimulating the surfaces of the *human* brain in cases where accident or operation has exposed the proper regions. Thus pathology, anatomy, and physiology all point to the same intimate relation of mind and body and indicate more specifically than the observations of every-day experience could do, a fixed and positive relation between definite parts of the nervous system and such special phases of consciousness as the visual, the auditory, etc.

Moreover, comparative anatomy, comparative physiology, and comparative psychology all converge upon another cognate principle, *i. e.*, that the development of consciousness among various genera and species of the organic world has run parallel with the development of the nervous system. Taking all these considerations into account, the deliverances of common sense as well as the teachings of science, it is easy to understand why the modern psychologist finds it judicious in his study of consciousness to learn all that he can about the nervous system, the sense organs, and the motor mechanism.

The Nervous System.—It will assist us in gaining a working idea of the nervous system to bear in mind the fact that its fundamental function consists in the conversion of incoming nerve impulses into outgoing nerve impulses causing movements of a kind tending to preserve the creature. The stimulations to which it responds are such things as light, heat, sound and mechanical pressure, together with various other physical and chemical processes of nature. Creatures destitute of some form of nervous system are practically incapable of prompt and appropriate adaptation to their surroundings. Plants are thus in large measure the passive victims of their environments. Injury to one part commonly produces little or no immediate effect upon the rest of the plant. But by means of its nervous system every part of an animal organism is brought into vital connection with every other part and with the outside world. Adaptive coöperation becomes the controlling principle in the life activities. This coöperation, or coördination, takes the form of movements made in response to sensory stimulations, and the most highly evolved type of nervous system, such as that of the human being, differs from a very rudimentary one, like that of the jelly fish, only in the form and complexity of the devices by which these stimulations and movements are connected. When studying the structure of the nervous system, it should always be remembered that this fact about the co-ordination of stimuli and movements offers the clue by which even its most intricate arrangements may be interpreted.

The Elementary Structures.—The nervous system is made up of elementary structures called neurones. A sketch

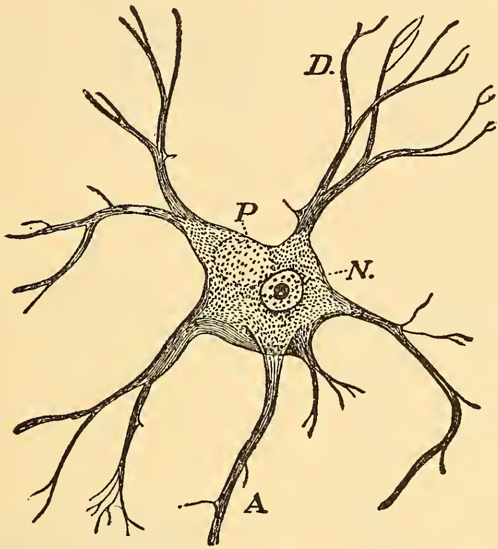


FIG. 1. Isolated body of a large cell from the ventral horn of the spinal cord of man. Multiplied 200 diameters (Donaldson after Obersteiner). *A*, axone (each cell has but one); *D*, dendrites; *N*, nucleus with enclosures; *P*, pigment spot.

of certain common forms of neurones is shown in figures 1, 2, and 3.* It will be seen that the neurone is a protoplasmic structure made up of a cell-body containing a nucleus, and often within this nucleus smaller neucleoli, while from its

*This chapter cannot be thoroughly mastered without a careful study of the cuts and diagrams. The conception of the nervous system which is adopted is that at present generally prevalent among neurologists. It must be remembered, however, that the science of neurology is growing with astonishing rapidity, and radical changes of doctrine are consequently possible at any time.

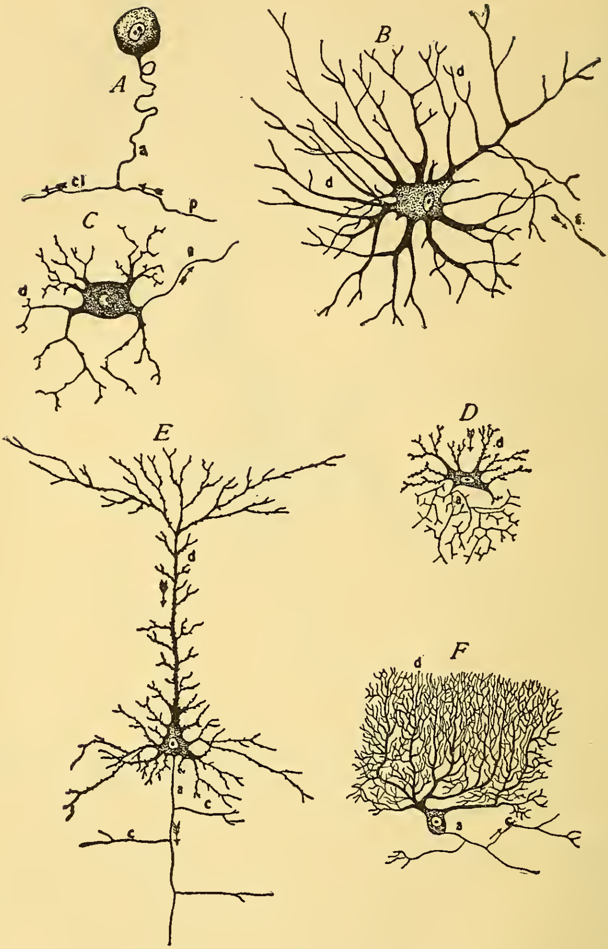


FIG. 2. *A*, cell from the spinal ganglion; *B*, cell from the ventral horn of spinal cord; *C*, cell from the sympathetic, *D*, cell from the spinal cord; *E*, pyramidal cell from the cerebral cortex; *F*, cell from the cerebellar cortex; *a*, axones; *d*, dendrites; *c*, collaterals; *p*, peripheral part of the fibre; *cl*, central part. Arrows indicate the direction of conduction for nervous impulses. (Modified from Morris and from Toldt.)

surfaces are given off filaments of various forms and sizes. The filaments range in length all the way from a fraction of a millimetre up to five feet, and in bulk they generally exceed the cell-body very much. The whole structure, including both *filaments* and *cell-body,* constitutes the *neurone.* It has been estimated that in the nervous system of the adult

FIG. 3. *A-D,* showing the *phylogenetic* development in a series of vertebrates; *a-e,* the *ontogenetic* development of growing cells in a typical mammal; in both cases only pyramidal cells from the cerebrum are shown; *A,* frog; *B,* lizard; *C,* rat; *D,* man; *a,* neuroblast, or young cell, without dendrites; *b,* commencing dendrites; *c,* dendrites further developed; *d,* first appearance of collateral branches; *e,* further development of collaterals and dendrites; *ax,* axones; *de,* dendrites; *cl,* collaterals. (Modified from Donaldson after Ramón y Cajal.)

human being there are about 11,000 millions of these neurones in various stages of development. Their average volume is probably about .00009 of a cubic millimetre.

Certain of the fibrous processes of the neurones are called axones or neurites, others are known as dendrites. The axones, as may be seen from figures 2 and 3, are generally smooth in their contours, and when they branch, the divisions commonly occur at right angles. Each neurone has but a single axone. These axones are the 'fibres' of common parlance, the dendrites being from the structural point of view

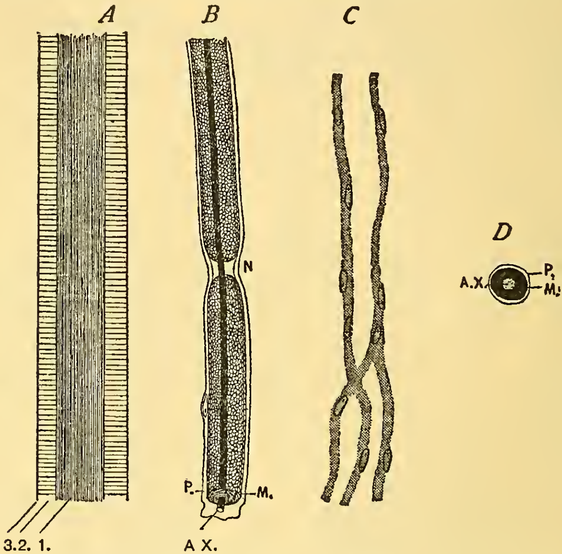


FIG. 4. *A*, diagram of medullated nerve fibre; 1, the axis cylinder; 2, the medullary sheath; 3, the primitive sheath or neurilemma; *B*, a sketch of medullated nerve fibre; *AX*, axis cylinder; *M*, medullary sheath; *P*, primitive sheath; *N*, node of Ranvier; *C*, fibres of the sympathetic system. They are in the main unmedullated; *D*, a cross section of *B* showing the same structures. (Modified from Toldt and Thorndike.)

essentially parts of the cell-body. Within the central nervous system the dendrites are rougher and branch more gradually from one another, somewhat like the sticks of a fan. The fully developed axones have a peculiar structure, shown in figure 4. The central strand is known as the axis cylinder. This is a transparent mass which constitutes the true nerve, and conducts the nervous impulses from one point to another. Outside the axis cylinder is a relatively thick covering known as the medullary sheath. This sheath is secondarily acquired and generally disappears near the cell-bodies and also wherever the fibre terminus approaches other fibre terminals. Outside of this again there is a thin nucleated membranous sheath known as the neurilemma, found, however, only outside the central nervous system, *i. e.,* in regions outside the spinal cord and brain.

Functions of Elementary Structures.—Although the cell-body and fibre are really parts of a single organic cell—the neurone—their notable difference in appearance is accompanied by certain differences in function. Both cell-bodies and fibres are sensitive to stimulation, *are irritable,* as the physiologists say, and both possess conductivity. In addition to these functions the cell-bodies have ordinarily been supposed to possess the capacities of either reinforcing or inhibiting the impulses sent to them. It has also been believed that at times they send out nervous excitation along the fibres without any detectable external stimulation, *i. e.,* that their action is occasionally automatic. Whether the cell-bodies really possess these properties or not, at least they furnish a rich system of interconnections for the neurones by means of the fibres which radiate from them as centers.

It seems to be well established, too, that the cell-bodies exercise highly important nutritive functions. Certainly if the cell-body be destroyed, the fibre promptly dies. Indeed, certain neurologists hold that the cell-body is not necessarily involved in the truly nervous activity of the system at all, but is mainly confined to these nutritional functions.

Recent investigations strongly suggest that the places at which neurones come into active relations with one another, *i. e.,* their terminals, are much more important than had been suspected. Some of the functions formerly attributed to the cell-bodies, particularly those of inhibition, may be properties of these junction regions. The term 'synapsis' is generally used to designate these unions. The nature of the contacts will be described presently.

On the whole it seems doubtful whether the differences between the nervous functions of the cell-bodies and the fibres are as marked as was until recently believed, but in any case the neurones are so linked together as to bring sensitive end-organs, like the eye and ear and the nerves of the skin, into relations with (1) the various nervous centers of the brain and spinal cord, and through these with (2) the muscles and glands.

It is supposed that inside the central nervous system the axones are ordinarily employed to carry impulses away from the cell-bodies, whereas the dendrites probably carry impulses toward them. Outside the central system the afferent fibres leading to the spinal ganglia resemble axones in structure, and so offer apparent exceptions to this rule. Moreover, in certain cases the axones seem to be given off from dendrites, so that the nervous current in passing from one to the other need not enter the cell-body. Whether this appearance be misleading or not, the usual arrangement is undoubtedly one in which the cell-body intervenes between the axone and the dendrites. In any event the whole nervous system is nothing but an aggregation of neurones, in a frame of connective tissue, blood-vessels and lymphatics combined, with the supporting tissue, called neuroglia, which holds the neurones in place. A nervous impulse originating in the sensory surface of the body, for example in the retina, may be transmitted from one group of neurones to another, until finally it issues, perhaps, from the nerves of the spinal cord, and produces a movement of the foot. This is what would occur if one should step aside upon seeing a heavy object about to fall. In this process of transmitting the impulse through the nervous system, it is not necessary that the groups of neurones should be actually in contact with one another, although this may occur. But they must at least be close together.

The Nervous Current.—The exact physical nature of neural excitement is not known. Various theories have been propounded in the effort to identify it with recognised forms of chemical or electrical activity, but thus far no hypothesis has been suggested which accords satisfactorily with all the facts. Meantime, we speak of the nervous current, the neural disturbance or excitement, in a purely metaphorical way, to cover the facts which we do know, *i. e.*, that physiological activity of a certain kind occurs in the nervous structures, and is transmitted very rapidly from one point to another. In man the rate of this transmission is about 100 feet per second.

Various Forms of Nervous System.—When we turn to the zoölogist and the comparative anatomist, we are able to obtain certain interesting facts about the development of the nervous system throughout the organic kingdom. From such sources we learn that the simplest types of animal organism, *e. g.*, such protozoans as the amœba, possess no nervous system at all. Every part of the surface of the unicellular amœba (figure 5) is capable of movement, of assimilating food and excreting the waste products. This animal's behaviour suggests that other forms of tissue besides nervous tissue are sensitive and capable of conducting impulses. Undoubtedly this is a fact, and we must accordingly think of the nerves as simply specialised forms of protoplasm in which these functions are more highly developed than elsewhere. In certain of the lower metazoans nerve cells appear with fibres extending toward the periphery of the body and possessing sensitive

Fig. 5. Diagram of an amœba. The irregularly shaped mass of protoplasm is shown with *N*, its nucleus, and *CV*, a contractile vacuole, which expands and contracts.

terminations. Among the cœlenterates a very simple nervous system comes to light. In hydroids this is merely a kind of tissue of nerve cells. In echinoderms we meet with a structure like that shown in figure 6. But it is not till we reach such forms as the worms that we find a definite organised centre of control, like the brain or spinal cord. In the annulates of the worm forms there is not only a centre corresponding to a very rudimentary brain, but also one roughly corresponding to the spinal cord. (Figures 7 and 8.) In the molluscs the development is made more complex by the appearance of these groups of central cells clustered together in several directions about the brain. (Figure 9.) Even in the lowest forms of vertebrates, *e. g.*, the acranial amphioxus, we find both a brain and cord. Passing from the lowest to the highest vertebrates up, for example, through the fishes, amphibians, and reptiles to the birds and mammals, we meet with every shade of variation in the development of the several parts of the nervous system. Everywhere, however, from the most primitive metazoan up to man, the general principle is one and the same—a mechanism for connecting sensitive receptive organs with muscles and glands.*

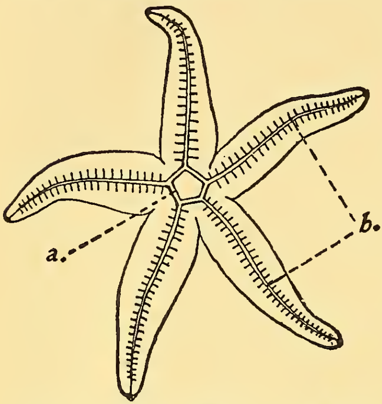


FIG. 6. Nervous system of a starfish; *a*, central nerve ring that surrounds the mouth; *b*, peripheral nerves of the arms. (After Loeb.)

The Development of the Gross Structures of the Human

*Readers who wish simply a general impression of brain organization and action, as related to consciousness, rather than a more detailed knowledge, will do well to omit from this point to the paragraph on page 39 dealing with the cerebrum.

System.—If we were to examine the human nervous system at one period of its embryonic development, we should find it a crude structure of tubular form, with one end enlarged, and slightly constricted at two zones, as shown in figures 10, A, B, C. In certain regions the walls of this enlarged portion thicken and spread out as they grow, whereas in several places they dwindle away to a mere membrane. In this manner the various parts of the adult brain are formed, retaining to the end the old tubular contours. The remnant of the cavities in the embryonic brain and cord become respectively the ventricles of the developed brain and the canal of the spinal cord. (Figures 11A and B.) These cavities remain connected with one another and are filled with the cerebrospinal fluid. The surfaces of the brain and cord are closely invested with a membrane, the pia mater, carrying blood-vessels. This membrane is bathed on its outer surfaces by fluids. A tough, thick membrane, the dura mater, separates the pia mater from the bones of the skull and vertebræ. (Figures 12 and 13 show the external appearance of the nervous system.)

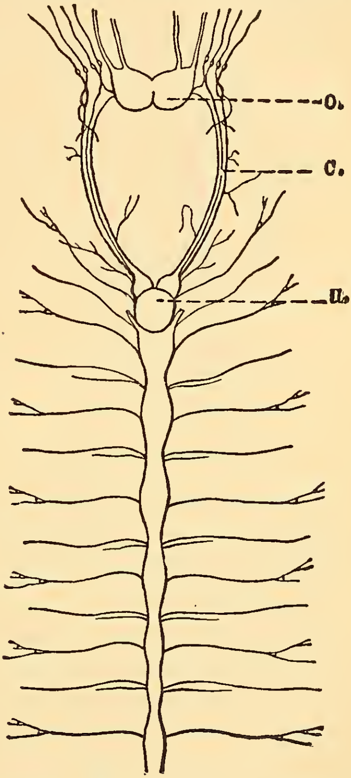


FIG. 7. The brain and a series of segmental ganglia of an annelid (Nereis): *o*, supraœsophageal ganglion, or brain; *c*, commissure; *u*, subœsophageal ganglion. (Loeb after Claparède.)

The portion of the embryonic brain known as the fore-brain finally develops into the great masses of the cerebrum. [See in explanation of this paragraph figures 10B and C, 11A and B, 12, 13, and 14.] The optic thalami, which are large collections of nerve cells with their fibrous connections, also belonged originally to this general region of the brain. The primitive mid-brain changes less in mass during growth than does the fore-brain, and becomes on its under or ventral surface the crura or peduncles of the brain, while on its upper or dorsal surface it becomes the corpora quadrigemina. The hind-brain develops in its foremost part, dorsally into the cerebellum, and ventrally into the pons. In its lower portions it becomes the medulla oblongata, upon the dorsal surface of which appears the fourth ventricle, with its non-nervous membranous covering. The spinal cord undergoes the least profound change, as regards its external contours, of any of the embryonic parts of the central system.

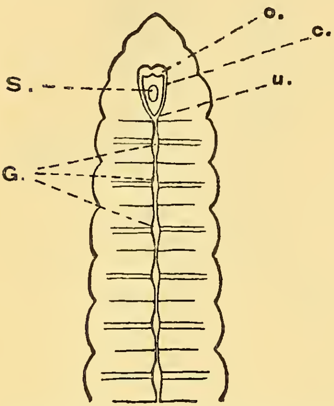


FIG. 8. Dorsal view of central nervous system of an earthworm; *o*, supraœsophageal ganglion; *c*, commissure; *u*, subœsophageal ganglion; *S*, pharynx; *G*, ganglia of the ventral cord. (After Loeb.)

When we take the facts of development into account, therefore, it becomes evident that the various portions of the brain, which seem at first glance so hopelessly confused in their relations to one another, are nevertheless all derived from a single relatively simple structure—the tubular embryonic nervous system. This is modified by certain flexures and inequalities of growth, but its walls are everywhere made up of neurones and their supporting tissues, the neuroglia.

The general form of the brain is complete some time before birth.

The number of neurones, the nervous element, is also complete at birth, though by far the larger portion is not mature or functionally active at this time. But the approximate maturity of the brain in point of size and weight is not reached until about seven years of age, and development in the interconnections of the neurones goes on indefinitely, certainly with most persons up to forty years of age. Recent investigations indicate that the weight of the brain diminishes after the twentieth year.

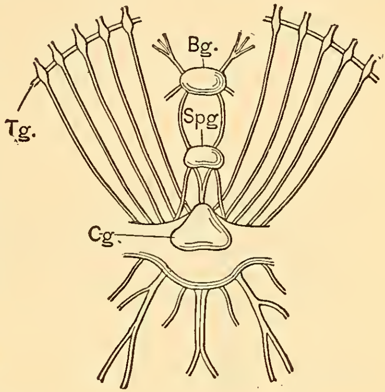


FIG. 9. Brain of a mollusc (Sepia); *Cg*, cerebral ganglion; *Spg*, supraœsophageal ganglion; *Bg*, buccal ganglion; *Tg*, ganglia of the tentacles. (Loeb after Claus.)

A Functional Grouping of Neurones.—The neurones of the central system may be grouped according to certain of their functions in three great divisions: (1) sensory neurones which bring nervous impulses in from the sense organs (Fig. 15A), (2) motor neurones which terminate in muscles and carry to them impulses from the nervous centres (Fig. 15B), and (3) central neurones which in various ways join together the members of the first two groups (Fig. 2, D to F). As we remarked earlier in the chapter, the nervous system seems to manifest its essential value as a device whereby appropriate movements are made in response to sensory stimulations. These three great neurone divisions represent therefore the fundamental elements in such a device, *i. e.*, mechanisms for transmitting stimuli inward, for transmitting them outward again and for combining the several sensory varieties of stimulation with the most varied kinds of muscular response.

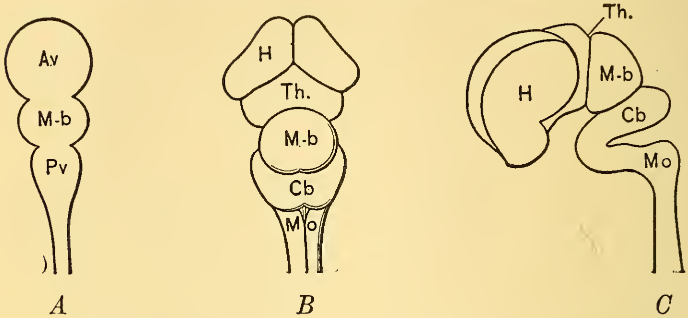


FIG. 10. *A, B, C.* Diagrams illustrating embryological changes in the brain, *Av,* anterior vesicle, or fore-brain; *M-b,* middle vesicle or mid-brain; *Pv,* posterior vesicle, or hind-brain; *H,* cerebral hemispheres; *Th,* thalamus; *Cb,* cerebellum; *Mo,* medulla oblongata. (James after Huguenin.)

The sensory neurones leading from the different sense organs, *i. e.,* in the eye, ear, nose, tongue, skin, muscles, tendons and other deep-lying tissues, put the organism in contact with the most diverse forms of motion in the physical world, *e. g.,* light, sound, temperature, etc.* It is as though the organism were supplied with so many telephones sensitive to each of these forms of physical communication. We shall describe the sense organs in the chapter on sensation. Among the vast numbers of central neurones we shall find those of the cerebral cortex most significant for mental life. It is with these that the fate of our conscious processes seems most intimately bound up. The action of the central neurones becomes finally effective through the discharge of their nervous energy into the motor neurones. Such discharges

*It will of course be understood that the immediate sensory stimulus to the nerves of the muscles, tendons and joints is ordinarily muscular movement. The subject is further discussed, together with certain other intra-organic sense processes, in the chapter on sensation.

occasion our muscular movements and lead to the various acts which constitute our conduct—the things we say and the things we do.

An Anatomical Grouping of Neurones.—Following Ebbinghaus and others we may also classify the neurones of the central nervous system on an anatomical basis in three general groups, (1) the peripheral neurones, (2) the subcortical neurones, and (3) the cortical neurones. This classification is based on the location of the cell-bodies of the neurones and it must not be understood as invalidating the first classi-

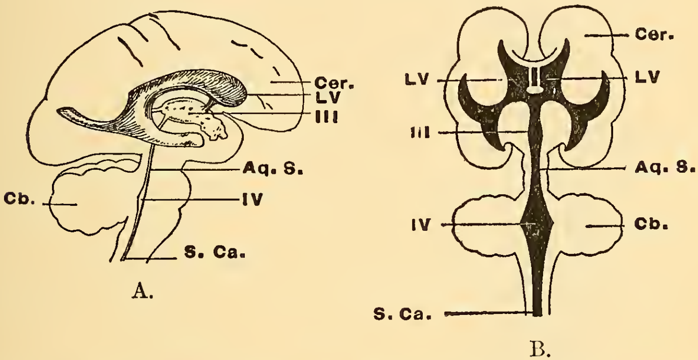
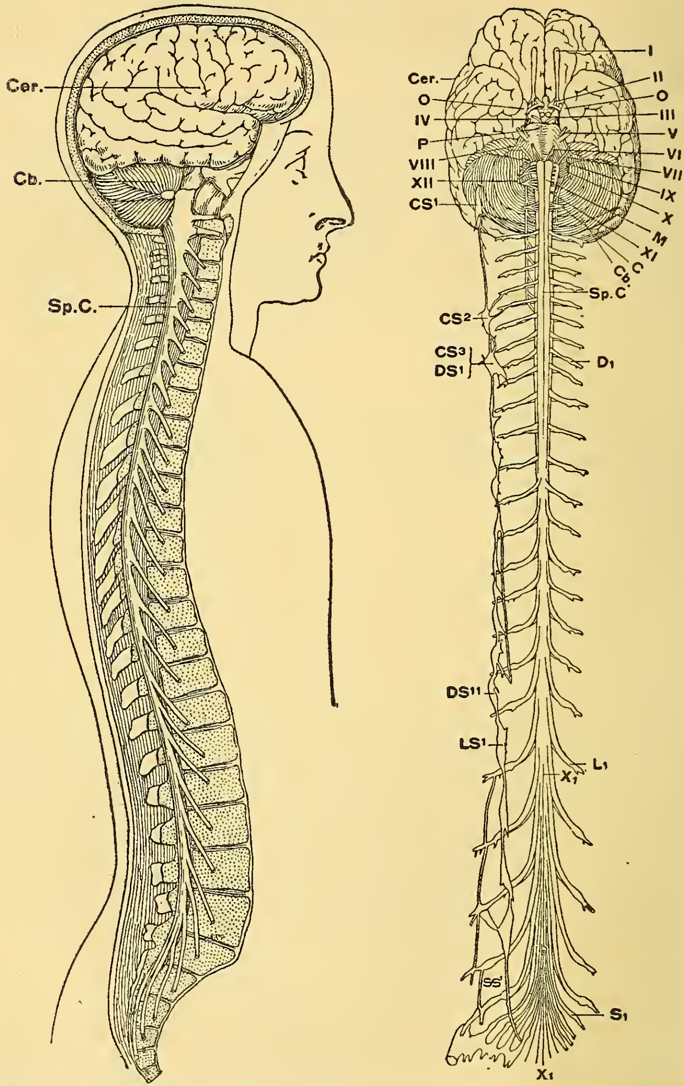


FIG. 11. *A.B.* Diagrams to illustrate the position of the ventricles and the spinal canal with the connecting channels. The figure at the left represents the ventricles as seen from the right side projected against the outline of the brain. The figure at the right represents diagrammatically a cross section through the ventricles as seen from in front projected against the outer contours of the brain. *Cer.*, the cerebrum; *LV*, the lateral ventricles; *III*, the third ventricle; *Aq.S.*, the aqueduct of Sylvius joining the third and fourth ventricles; *IV*, the fourth ventricle; *Cb.*, the cerebellum; *S.Ca.*, the spinal canal.

fication. The two groupings are supplementary to one another. The first method of division gives us a rough working impression of how certain of the neurones differ in the service they render, without much regard to their relative positions. The present classification affords a much



FIGS. 12 and 13. Figure 12 at the left shows the general relations of the central nervous system to the bones of the skull and more detailed and accurate impression of their topographical relations to each other. Apparently no single classification will serve equally well to bring out the two kinds of relations.*

Peripheral Neurones.—The peripheral neurones of this classification are substantially identical with the sensory neurones of the previous classification. *Their cell-bodies lie outside the central system, i. e.*, outside the spinal cord and brain, and are sometimes situated near the central structures, as in the case of the cells in the ganglia of the posterior roots of the spinal cord. These cells of the spinal cord ganglia distribute their sensory fibres to the skin, muscles, tendons, etc. Sometimes, however, the cell-bodies of the peripheral neurones are in the neighborhood of the sense

*On the basis of recent investigations a division of the nervous system is proposed which promises to be very useful. The entire system, both central and sympathetic, is thought of as composed of four columns in each half of the body, eight altogether. (1) A sensory somatic, (2) a motor somatic, (3) a sensory visceral, and (4) a motor visceral. The first and second group would include all sensory and motor processes affecting the adjustment of the organism directly to the environment. The third and fourth divisions would include all processes concerned in the nutritional activities.

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spine. Figure 13, at the right, displays the general contours of the central system as seen from in front. The great ganglionated cord of the sympathetic system is shown attached to one side of the spinal nerves; the other side has been cut away. *Cer.*, the cerebral hemispheres; *O*, the olfactory centres; *P*, the pons Varolii; *M*, the medulla oblongata; *Cb.*, the cerebellum; *Sp.C.*, the spinal cord; *I*, the olfactory nerve; *II*, the optic nerve; *III*, the oculo-motor nerve; *IV*, the trochlear nerve; *V*, the trigeminus nerve; *VI*, abducens nerve; *VII*, the facial nerve; *VIII*, the auditory nerve; *IX*, glosso-pharyngeal nerve; *X*, the vagus nerve; *XI*, spinal accessory; *XII*, the hypoglossal nerve; *C*, the first cervical spinal nerve; D_1, the first dorsal, or thoracic, nerve; L_1, the first lumbar nerve; S_1, the first sacral nerve; X_1, filum terminale; CS^1, superior cervical ganglion of the sympathetic; CS^2, middle cervical ganglion of the sympathetic; CS^3, and DS^1, junction of the inferior cervical and the first dorsal, or thoracic, ganglion of the sympathetic; DS^{11}, the eleventh dorsal, or thoracic ganglion, of the sympathetic; LS^1, the first lumbar ganglion of the same system; SS^1, the first sacral ganglion also of the sympathetic.

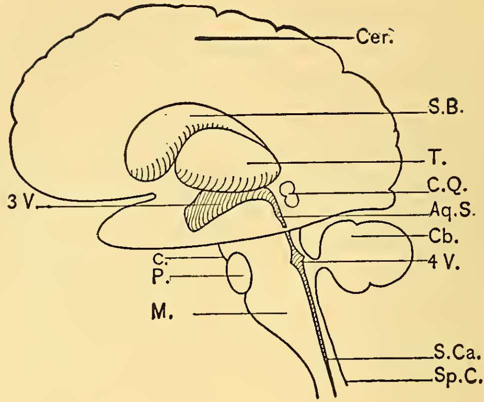

FIG. 14. *Cer.*, the cerebral hemispheres; *S.B.*, striate body of the left half of the brain; *T.*, left half of the thalami; *C.Q.*, corpora quadrigemina; *3V*, third ventricle; *Aq.S.*, aqueduct of Sylvius; *Cb.*, cerebellum; *C.*, the crura, or pillars of the brain; *P.*, the pons Varolii; *4V.*, the fourth ventricle; *M.*, the medulla oblongata; *S.Ca.*, the spinal canal; *Sp.C.*, the spinal cord. The drawing is purely diagrammatic and should be interpreted in connection with figures 10, B and C, and 11, A and B.

organ, as in the case of the auditory nerve, which arises from a cell in the internal ear; the optic nerve, which has its cell-body in the retina, etc. (See cuts in Chapter V.) The function of the peripheral neurones is evidently that of transmitting impulses from the sense-organs into the nervous centres, and we need discuss them no further at this point.

Subcortical Neurones.—The subcortical group involves all the gross structures in the central system save the cortices of the cerebrum and the cerebellum on the one hand and the peripheral (sensory) neurones on the other. Their function is in general that of furnishing neural mechanisms for the innervation of muscles and for connecting with one another the various parts of the central system below the cortices. This can be best brought out by examining separately some of the more conspicuous gross structures of this group. After doing this, we shall discuss the cortical groups, and their functions as general control centres. It will be appreciated at once that the subcortical neurones include both the motor neurones and the central neurones of the previous classification, except of course those of the cerebral and cerebellar cortices.

The Spinal Cord.—We may first consider the spinal cord (figure 13). If we take a cross section of this organ, cutting through at right angles to its long axis, we find a structure

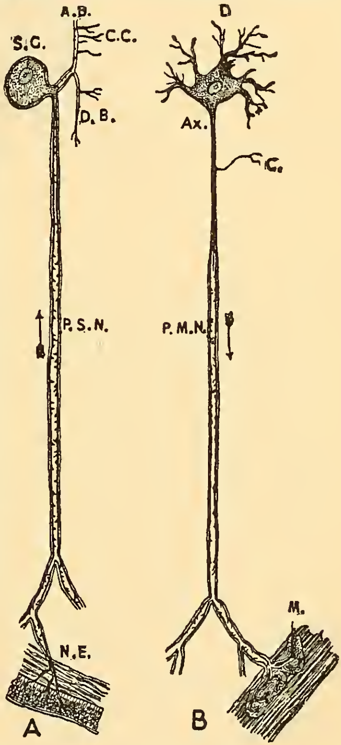

FIG. 15. A, a peripheral sensory nerve originating in the ganglion of the posterior fibre bundle of the spinal cord. *N. E.*, free nerve ending in the skin; *P. S. N.*, peripheral medullated nerve trunk; *S. G.*, spinal ganglion; *A. B.*, ascending branch of the axone; *D. B.*, descending branch of the same, both branches being inside the spinal cord proper; *C. C.*, collaterals from the axone. *B*, motor neurone of the ventral horn of the spinal cord sending a fibre down to a muscle. *D.*, dendritic processes; *Ax.*, axone which takes on its medullary sheath as it passes out from the central nervous structure of the cord; *C.*, a collateral; *P. M. N.*, the main body of the peripheral motor nerve; *M.*, the muscle plate ending of the nerve on the muscle fibres. Arrows indicate in both A and B the direction in which impulses pass. (Modified from Toldt.)

such as is shown in figures 16 and 17. In the central portion, grouped about the spinal canal in the general shape of the letter H, is an area which appears a pink grey in the fresh state and which contains the cell-bodies of the neurones.

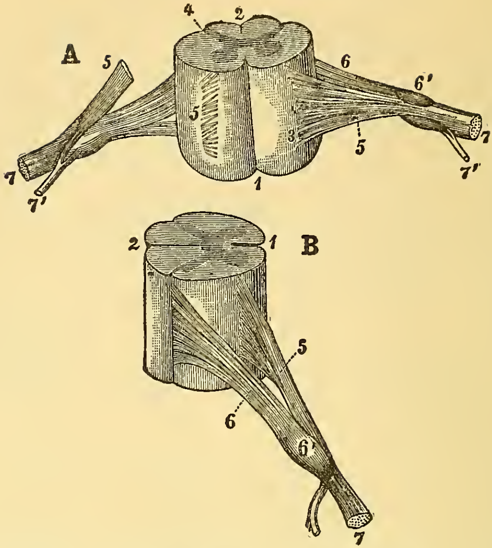

Fig. 16. Portion of cervical region of spinal cord. *A*, cord seen from anterior or ventral surface. *B*, cord seen from the lateral surface. *1*, ventral median fissure; *2*, dorsal sulcus; *5*, ventral fibres leaving the cord; *6*, dorsal fibres entering the cord; 7, spinal nerve after the union of the dorsal and ventral bundles of fibres; 7^1, fibres to and from the sympathetic system. (After Barker and Rauber.)

Outside of this is a thick layer of white nerve fibres. Close examination of the grey matter reveals fibres running out laterally to penetrate the white masses. A large number of the fibres from the cell-bodies in the ventral or anterior region of the grey mass pass out from the spinal cord in bundles, finding exit between the several spinal vertebræ (figure 12). Thence they may be traced principally to the voluntary muscles of the limbs and trunk. These are the motor neurones of the functional classification. The fibres entering the dorsal or posterior region of the grey matter arise in the cells of the spinal ganglia and pass in similar bundles to the posterior side of the cord; while corresponding fibres on the distal side of the ganglia, after uniting with the

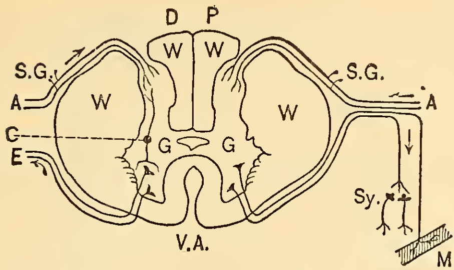

FIG. 17. Diagrammatic cross-section of the spinal cord. *W W*, white fibrous matter; *G G*, grey cellular matter; *A*, afferent sensory fibres passing through *S.G.*, the spinal ganglion, into the posterior horn of the grey matter; *E*, efferent motor fibres, most of which lead to muscles like *M*, many of which connect with the sympathetic ganglia, like *Sy.*; *C*, central cell probably traversed as a rule by impulses passing from *A* to *E*. *D. P.*, dorsal, or posterior, surface of the cord; *V. A.*, ventral, or anterior, surface.

bundles from the motor region, are distributed chiefly to the sense organs of the skin, joints, muscles, tendons, etc. It may be remarked at this point that the voluntary muscles, such as control the movements of the hand, are commonly striped muscles, whereas the involuntary muscles, *e. g.*, those of the alimentary and circulatory systems, are generally unstriped. The unstriped muscles are mainly connected with the autonomic nervous system, of which we shall speak briefly a little later. The striped muscles contract and relax more rapidly than the unstriped.

Functions of the Spinal Cord.—The arrangement of the elements in the spinal cord suggests at once two of its principal functions, and is so typical of the facts generally characterising nervous structure and function that it seems judicious to comment upon it briefly. It will be observed in the first place that in the cord sensory and motor neurones, connected through their fibres with the sense organs and the muscles respectively, are in very close proximity to one another. It should be relatively easy, therefore, for an incoming sensory impulse to find its way out over motor nerves

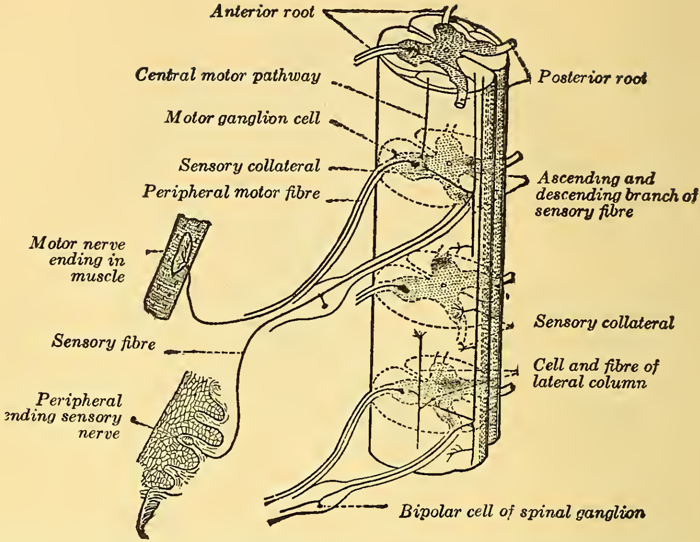

FIG. 18. Schematic representation of sensory and motor pathways in the cord. (After Toldt.)

and so to produce reflex movements, that is, movements made in immediate response to sensory stimulations, without passing to the brain and involving the guiding action of the cerebral cortex. This is precisely what happens, and it is as a reflex mechanism that the spinal cord exercises *the first* of its important functions. As instances of such reflexes we may mention the twitching of the toes and the jerking of the foot when the sole is tickled. The number of these reflexes is large. Furthermore, we should find upon examination that the white fibrous tracts along the external surfaces of the cord connect it with both the higher and the lower parts of the system. (Figure 18.) It should thus be easy for impulses to pass upward and downward, between the brain on the one hand and the sense organs and muscles on the other. Such ready transmission actually occurs, and it is in this fact that we find the *second great* function of this organ. The spinal cord is accordingly typical of the central structures in general, in that it provides (1) means for the immediate connection of sense organs and muscles and (2) devices for connecting various parts of its own and other nervous structures with one another.

Functions of Other Subcortical Groups of Neurones.— If we were to examine the other subcortical masses lying between the cerebral hemispheres and the spinal cord, we should find that, in general, they consist of aggregations of neurones much like those in the cord, but on the whole less simply and regularly disposed. Thus, the medulla, the corpora quadrigemina, and the thalami all display cell or neurone groups with sensory and motor connections. When we come to speak of their specific functions, we are obliged to indulge largely in speculation, because the facts are evidently extremely complex, and our knowledge of the details involved is notoriously incomplete. Moreover, the specialised functions which are sometimes attributed to them in the case of the lower animals are probably in the human being largely usurped by the cerebral cortex. In any event we must always remember that the nervous system is an organic unit, and no part of it ever acts wholly independently of the other parts, nor is any influence exercised upon one part entirely without significance for the other parts. Any mention of specific functions of different regions must always be made with this reservation in mind. Thus, the spinal cord undoubtedly contains the neurones whose innervation is immediately responsible for movements of the hand. But the stimulus to this innervation itself may originate almost anywhere throughout the rest of the nervous system, so that any portion of this system may in a particular case contribute to the production of the special motor consequences. To say that a region of the nervous system presides over any special function is, therefore, simply to say that it is the portion most immediately and most invariably responsible for it.

Speaking within such limitations, we may say that there are two functions of centres lying in the medullic region, about which considerable unanimity of opinion exists. The automatic respiratory movements, and certain activities of the vaso-motor nerves (especially of the constrictors) which govern the calibre of the arteries, are controlled by neurones located in this neighborhood. These neurones discharge their impulses, however, in part through neurones in the spinal cord. Needless to say, all these regions are like the spinal cord in containing pathways for neural excitation to pass upward and downward, with the sense organs and the muscles as terminal points, between which the higher and the lower centres serve as intermediary connectors.

Although the olfactory nerve is given off from the forward ventral region of the cerebrum, the remaining cerebral nerves issue from certain of the subcortical centres, *e. g.*, the medulla, pons, thalami, etc. The cell-bodies from which these nerves originate are variously distributed in locations sometimes at a considerable distance from the point where the nerve trunk penetrates the surface of the brain. This statement applies to the nerves of special sense like the auditory, the optic and the gustatory, together with such motor nerves as those controlling the eyes, the tongue, the lips, etc. Figure 13 shows the topographical relations.

Segmental Character of the Central Nervous System.—It is commonly maintained that the structural pattern from which the human nervous system has been developed is of a segmental character, each part of it receiving sensory and motor nerves from relatively distinct regions, or segments, over which they exercise a definite and sometimes exclusive control. Thus sensory nerves from the foot enter the same region of the spinal cord from which issue the motor nerves controlling the movements of the foot. Another region sustains similar relations to the trunk, another to the arms and so on. In the human being the motor nerves can, indeed, be classified without serious ambiguity in this segmental way in accordance with the special muscles which they innervate, *e. g.*, those of the head, the upper trunk, the lower trunk, etc. But the complex central inter-connections of the sensory neurones in man—if we have in mind the way in which they operate and not simply their anatomical relations—make any such segmental divisions of them very hazardous, so that the application of the segmental idea to the interpretation of our human nervous action is somewhat uncertain.

The Cortical Neurones.—The Cerebellum.—So little is confidently known about the operations of the cortex of the cerebellum, that it will not be profitable to discuss it at length. Suffice it to say that by means of neurones which lead into it, as well as neurones which lead out, the cerebellum has a very rich connection with the cerebrum, the lower brain centres, and the spinal cord. The sensory connections with the latter organ are especially marked. It seems to be generally agreed that its functions are most intimately related to the reception and coördination of the sensory stimulations which originate within the body itself, *e. g.*, in the muscles, the viscera, the semicircular canals of the ear, etc. It is thus conspicuously involved in such actions as those by which we preserve our equilibrium and in general succeed in carrying forward well coördinated and balanced movements, like walking, sitting and standing. But just how it plays its part is not known. Certain authorities regard the evidence as warranting the assertion that the cerebellum is the *chief locality* for the reception of stimuli from the body itself, in contrast with the cerebrum which, they urge, receives primarily stimuli from outside, and especially stimuli acting at a distance from the body, such as light and sound.

The Cerebrum.—For the psychologist the cerebral hemispheres are the most interesting and most important portions of the nervous system. From the various lines of evidence mentioned earlier in the chapter, we know that consciousness is connected with this part of the brain in an exceedingly intimate way, and we shall consequently devote some little

FIGS. 19 and 20. Figure 19 shows the lateral surfaces of the right hemisphere of the cerebrum. Figure 20 shows the inner mesial surface of the left hemisphere. The section is made through the corpus callosum and the right hemisphere has been removed. The surfaces covered with colored dots are the so-called motor regions from which originate neurones in control of voluntary muscles. It is now generally held that this set of motor neurones is confined to the region in front of the fissure of Rolando, instead of being distributed on both sides of it, as was until recently regarded as the fact. Certain authorities are still disposed to maintain the older view. The sensory areas, which represent the receiving stations for sensory impulses from the periphery, are indicated by black dots. The regions most heavily dotted, in the case of both sensory and motor regions, are those most indispensable for the given function. The areas less heavily dotted are those which are either less uniformly employed in the exercise of the function, or whose derangement affects the secondary or more complex use of the function. For example, visual images and ideas may be disturbed by injuries which do not seriously impair crude sensations of sight. The areas free from dots are the association regions, which Flechsig has divided into a number of subordinate districts, but which we indicate without attempt to divide finely.

R, the fissure of Rolando; *M*, motor regions; *B*, sensory regions for bodily sense impressions, *e. g.*, touch, temperature, kinæsthetic. This region is often called the somæsthetic area. This region is now generally confined to the area posterior to the Rolandic fissure, but it is still held by certain authorities, as was formerly the common view, that the region extends in front of Rolando as well as behind it. *V*, visual centre; *H*, auditory centre; *O*, the olfactory centre, which extends in a great loop up over the corpus callosum. The extent of the area is at present quite uncertain and the drawing simply suggests the facts at present generally recognized. The confinement of motor and bodily areas to the region above the limbic lobe over the corpus callosum is also tentative, although asserted by competent investigators. *O.B.*, the olfactory bulb; *O.T.*, the olfactory tract; *O.T.A.*, occipito-temporal association area; *A.P.*, parietal association area, continuous with the occipito-temporal association area just mentioned; *A.F.*, frontal association area; *I.*, the island of Reil, another association area, to show which the cortical surfaces just above the fissure of Sylvius have been lifted up; *C.C.*, corpus callosum.
(Modified after Flechsig.)

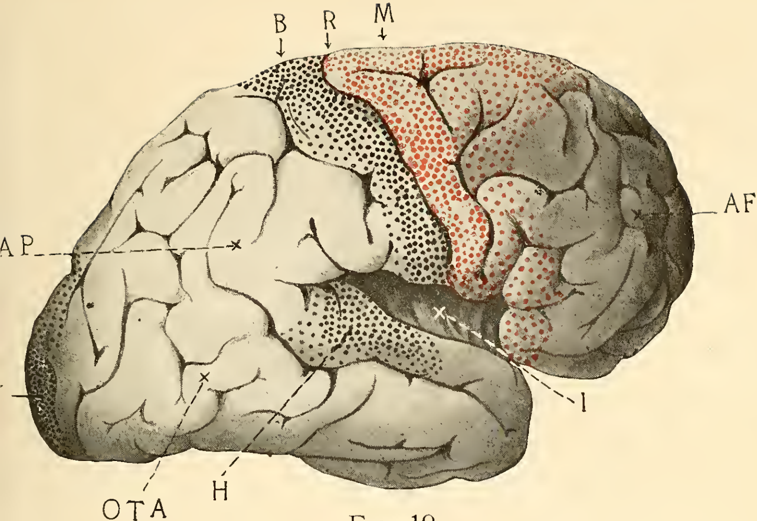

FIG. 19

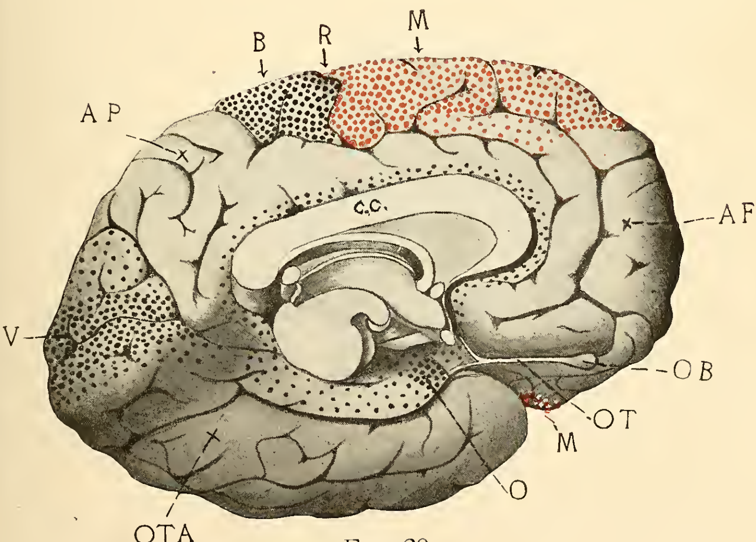

FIG. 20

space to its consideration. How far the lower brain centres in human beings may have directly to do with mental processes it is very difficult to say.

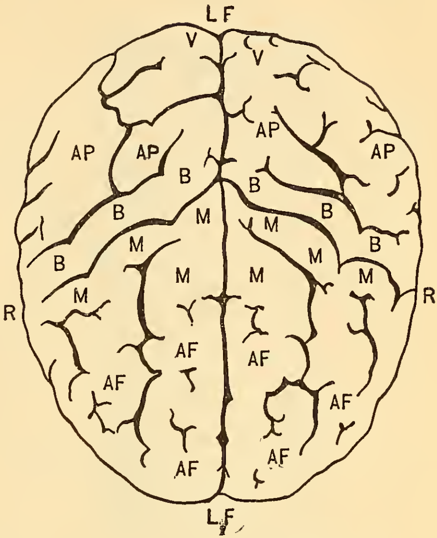

FIG. 21. Diagram showing cerebral hemispheres as seen from above. *LF*, longitudinal fissure separating the hemispheres; *RR*, fissure of Rolando. *VV*, visual regions of the occipital lobes; *AP*, parietal association centres; *AF*, frontal association centres; *MM*, motor centres; *BB*, centres for bodily senses of touch, temperature, etc.

The surface of the hemispheres, called the cortex, and shown in figures 12, 13 and 19 to 21, is made up of layers of cell-bodies, with their delicate processes. Roughly speaking the adult human cortex averages about three millimetres in thickness. The extraordinary richness of the dendritic development in the cortical neurones furnishes one of the most marked peculiarities of the human cerebrum, as contrasted with those of animals. This intricate dendritic structure apparently represents the bodily counterpart of those elaborate interrelations among ideational processes, which characterise in general the higher forms of intelligence. (Figure 22.)

Cortical Sensory Centres.—Certain of the cortical areas are known to be in functional connection with sense organs from which they receive stimuli. Thus, the region marked *H* is in connection with the ear, and receives auditory impressions. (Compare figures 19 and 21.) The region marked *V* is similarly connected with the retina, and receives visual impressions. It is reasonably certain that the areas marked *O* (figures 13 and 20) receive olfactory stimuli, while the region marked *B* is probably that immediately concerned with the reception of tactual, thermal, kinæsthetic and organic stimuli. The centres for taste are not clearly determined. It seems probable, however, that they are in the neighborhood of the olfactory terminals. There is reason to believe that

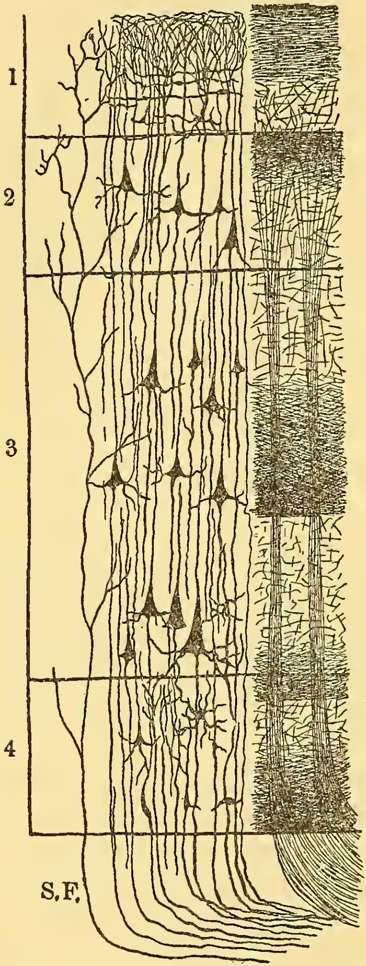

Fig. 22. Diagrammatic section of the cerebral cortex taken at right angles to the surface. The right side of the drawing illustrates the fibre system alone, the left side illustrates primarily the cellular layers. The structure is so complex that it is difficult to display both sets of facts in a single sketch. 1, molecular layer next the surface of the brain; 2 and 3, layers of pyramidal cells; 4, layer of polymorphous cells. *S. F.*, fibre of a sensory neurone entering to terminate in the outer molecular layer. (Modified from Morat.)

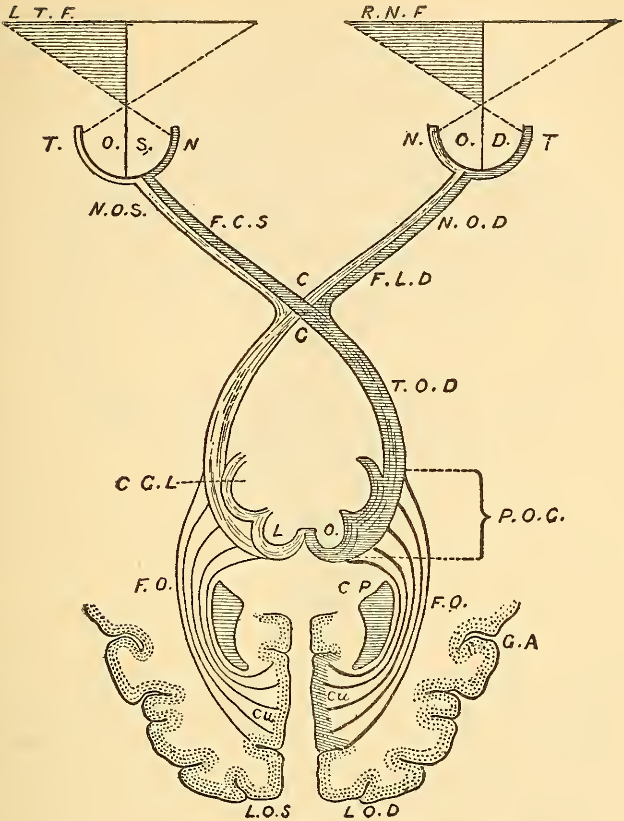

FIG. 23. Scheme of the mechanism of vision. (James after Seguin.) The cuneus convolution (*Cu*) of the right occipital lobe is supposed to be injured, and all the parts which lead to it are darkly shaded to show that they fail to exert their function. *F.O.* are the intra-hemispheric optical fibres. *P.O.C.* is the region of the lower optic centres (corpora geniculata and quadrigemina). *T.O.D.* is the right optic tract; *C*, the chiasma; *F.L.D.* are the fibres going to the lateral or temporal half *T.* of the right retina, and *F.C.S.* are those going to the central or nasal half of the left retina. *O.D.* is the right, and *O.S.* the left, eyeball. The rightward half of each is therefore blind; in other words, the right nasal field, *R.N.F.*, and the left temporal field, *L.T.F.*, have become invisible to the subject with the lesion at *Cu.*

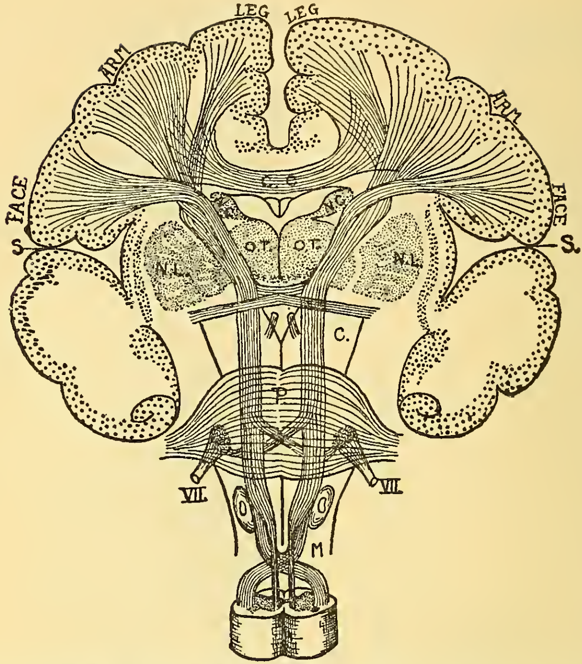

FIG. 24. Schematic transverse section of the human brain through the Rolandic region to show the crossing of motor fibres in the neighbourhood of the medulla. *S.*, fissure of Sylvius; *C.C.*, corpus callosum; *N. C.*, nucleus caudatus, and *N.L.*, nucleus lenticularis of the corpus striatum; *O.T.*, thalamus; *C.*, crus; *P.*, the pons; *M*, medulla oblongata; *VII.*, the facial nerves passing out from their nucleus in the region of the pons. The fibres passing between *O.T.* and *N.L.* constitute the so-called internal capsule.

ordinarily the peripheral sensory neurones are in connection mainly with the side of the cortex opposite to that from which they originate. For example, the touch nerves of the left hand find their cortical terminations in the right side of the hemispheres. The optic nerve, however, affords a curious modification of this plan. The neurones from the right side of each retina are connected with the right side of the brain, those from the left side, with the left hemisphere. (See figure 23.) In this particular, as in some others, the optic tract is peculiar. The retina itself differs from all the other sense organs in being a part of the brain, which has in the course of development been dislocated from its original position.

Cortical Motor Centres.—Another great group of these cortical cells in the region marked *M*, generally known as the region of Rolando, from its proximity to the fissure of that name, is well recognised as being in connection with voluntary muscles, which are controlled from this centre. The voluntary muscles of each half of the body appear as a rule to be controlled mainly by cells situated in the opposite side of the brain. (See figure 24.)

In addition to the Rolandic zone there are small motor areas in other regions of the cortex, notably one for eye movements in the occipital region, and no doubt one in the auditory region for the control of the ear movements which in man have so far lost usefulness as to have passed almost wholly out of voluntary guidance. In general each area of termination for sensory neurones is in close proximity to a region whence issue motor neurones controlling the muscles that move the part in which the corresponding sense organ is found. This arrangement has been described in the spinal cord. The Rolandic region enjoys its peculiar prestige largely because it governs almost all the important movements of the body, which are executed by muscles controlling regions for which the skin furnishes the sense organs. These senses are represented in the region adjoining the posterior edge of the Rolandic fissure. The arms, hands, body, legs and face all come under this caption and the Rolandic zone is accordingly that from which their movements are controlled. This representation of the skin senses at the Rolandic surfaces may account also for the representation there of motor control over areas already represented elsewhere. For example: the eye is not only a retina but also an organ with tactual senses and its cortical motor control is apparently divided between the occipital region where the retina is represented and the

Rolandic region where the tactual sensory tracts find their cortical termini.

Cortical Association Centres.—In view of such facts as we have just been rehearsing, the cerebral cortex has been described as a projection system, representing every sensitive point and every voluntary muscle in the body. There are, however, other large areas in the cortex which are not in immediate control of muscles, nor do they represent the emergence point for neurones in connection with the sense organs.* These centres marked *A* are called by Flechsig, who has studied them most carefully, association centres. The location of one of these centres, known as the island of Reil, lying beneath the fissure of Sylvius, although not shown well by our cuts, is indicated in figure 19. Their busi-

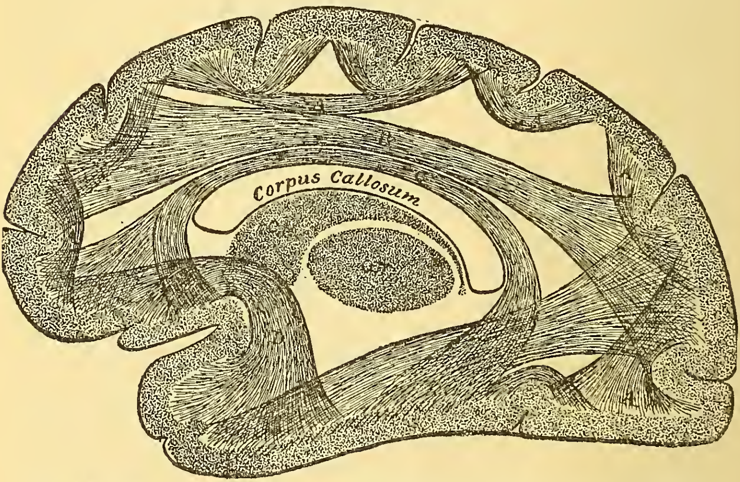

FIG. 25. Fibres associating the cortical centres with one another. (Schematic, James after Starr.)

ness seems to be that of uniting the several sensory regions, such as *H* and *V*, with one another and with the

*Certain authorities question this assertion, especially the latter portion of it.

motor region. (Compare figures 19 to 21 and 25.) It appears to be true in a general way that these association centres are relatively larger and more highly developed in those animals possessing most intelligence. There is another extremely important connecting mechanism, made up of cortical neurones the fibres of which form the corpus callosum (figures 24 and 25), by means of which the two sides of the hemispheres are brought into connection with one another. The hemispheres are also united by other less important bands of fibres, of which we shall not speak. These various devices make it possible for a cortical nervous impulse originating in the stimulation of some sense organ, like the ear, to pass into other cortical regions, like that belonging to vision, and thence out through the Rolandic zone to some muscle, producing, perhaps, a voluntary movement. This is probably what would occur, for example, were we to hear the words "Draw a horse," then to think how a horse looks, and then finally to make the appropriate movements of our hands. Both hemispheres would be involved in such activities. These relations and others similar to them are suggested by figure 26, which is, however, merely diagrammatic.

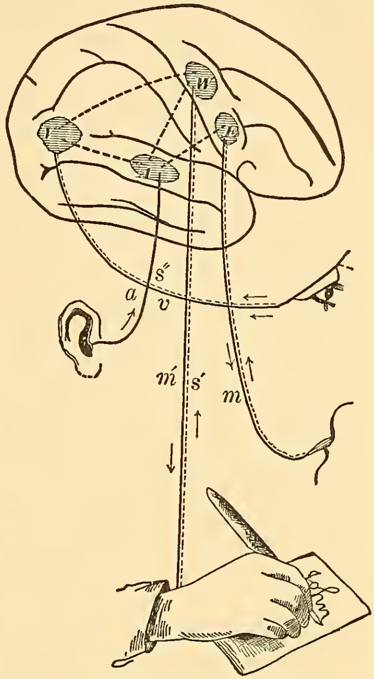

FIG. 26. *A* is the auditory centre, *V* the visual, *W* the writing, and *E* that for speech. (After James.)

The Cerebral Cortex and Mental Processes: A. Memory and Sensation.—When we contrast the cerebral cortex with the other parts of the nervous system, with reference to its significance for consciousness, we find that it is in the memory processes that the most conspicuous differences first come to light. If one suffers the destruction of the retinæ by accident or disease, or if the pathways be interrupted anywhere between the retinæ and the cortex, one becomes blind, but that may be all. When, however, as occasionally happens, one loses the use of the occipital regions, one may not only become blind, but one's visual *memory* also is lost. It is not possible to remember how familiar objects look. In slight injuries to the occipital region, as well as in minor injuries to the parietal association areas, objects may be seen without being recognised. So-called word-blindness, or visual aphasia, is caused in this way, the patient being unable to recognise or understand written words. If the injury is confined to one side of the brain the common result is hemianopsia in more or less serious form, *i. e.,* blindness to one-half of the field of view, owing to the destruction of the cortical centres receiving the fibres from the corresponding halves of each retina. It is said that the hemianopsia does not ordinarily affect the fovea, *i. e.,* the central point of clearest vision in each retina. Similarly, when the auditory region is injured, one loses the memory of auditory experiences. If in this case, as frequently happens, the disorder be confined to one side of the brain, and this be the side most highly developed (the left side in right-handed people), one cannot understand what is heard. This disease is known as auditory aphasia. The patient is not deaf, for the less developed and uninjured half of the cortex may serve for the production of vague auditory consciousness, but the associations which words and familiar sounds ordinarily evoke are wholly gone, because these were possessions of the now diseased side. The mental condition is not unlike that of a person hearing an unknown foreign language. He is not deaf to the words, but they mean nothing to him, for they have no associations. Certain cases have been reported which suggest that musical memory may be so specialised in the auditory sensory-motor complex upon which it depends, as to be obliterated by cortical lesions which leave the general auditory capacity largely unaffected.

B. Motor Control.—A condition closely comparable to sensory aphasia is that of motor aphasia, a disease in which one cannot articulate coherently. One is not necessarily dumb, and there may be no true paralysis of the articulatory muscles. But one simply cannot make the enunciatory movements in their correct order. This disorder is often found connected in right-handed persons with diseases of the left side of the motor region of the cerebral cortex, which is in control of these muscles. (Compare figure 24.) But it may be brought about—and often is—as a secondary consequence of auditory aphasia. If, when we speak, we are in the habit of having in our minds just prior to enunciation the auditory image or thought of how the words are going to sound, any difficulty which prevents our securing these auditory images will effectually check our utterance. Now auditory aphasia involves precisely this difficulty in commanding auditory images. As most of us do actually employ auditory thoughts to innervate our speech muscles, for we learn to speak as children by imitating sounds, it is surely not unnatural that auditory aphasia should so often be accompanied by motor aphasia. Cases are on record of persons who employed visual instead of auditory imagery to innervate the speech muscles, and who, upon suffering from lesions in the visual regions of the brain, were seized with motor aphasia. The sensory-motor arc, or circuit, as we have previously remarked, represents the unit of action, finding no exception in the activity of the complex cortical centres, and any interruption of it in the sensory portion may be as fatal to its proper operation as a defect in the muscles themselves. This is brought out in the accompanying diagram, figure 27.

Further Formulation of the Facts Described Under A and B.—Such facts as these just described indicate to us that memory is in a peculiar way dependent upon the integrity of the cortex. Visual ideas, tactual ideas, auditory ideas, and the like can apparently be recalled only when the several parts of the cortex with which these functions are connected are intact. In the first instance a visual conscious-

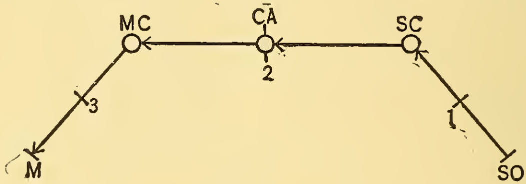

FIG. 27. *SO*, a sense organ; *SC*, a sensory cortical centre; *CA*, central association centre; *MC*, a cortical motor centre; *M*, a muscle. If *M* has become accustomed to contracting in response to a stimulus from *SO*, any interruption of the neural pathway joining the two, whether at *1*, or *2*, or *3*, may destroy the coördination and render *M* temporarily ineffective.

ness involves not only a visual cortex, but also a retina, and more or less of the intermediate organs between the two. A similar thing is true of the relation of all the other sense organs to the various elementary forms of sensory experience, such as touch, sound, taste, etc. But once the sensory experience has occurred, the cortex instantly takes up the impress and memory becomes possible. Destroy any part of the nervous system save this, and conscious memory may escape destruction. Destroy any specific sensory region in this cerebral cortex, and the corresponding sensory memories are obliterated or seriously deranged. Destroy a region in the motor zone, and the voluntary control of some muscle, or group of muscles, is affected. Destroy or injure the association centres, and the intelligent conjoining of ideas, impressions, and movements is likely to be impaired.

The character of the defect seems dependent in a measure on the particular association area injured. Injuries to the frontal lobes are likely to be marked by disorders of attention, concentration and the higher mental and emotional capacities. Injuries to the parietal association centres on the other hand are likely to be distinguished by disturbances in ability to connect ideas and sensations with their proper companions. Things seen, heard and touched fail to call up appropriate ideas and are accordingly improperly understood and interpreted. Experiments on monkeys seem to show that in those animals at least the frontal lobes play an essential part in learning new acts. So far as it goes, this fact harmonizes with the observations on human beings.

Owing to the great *individual* variation in the development of the different portions of the central nervous system, the gravity and permanency of these psychical disorders brought about in the way suggested, *i. e.*, by destruction of certain areas, varies very greatly under different conditions, so that the statements as made must be understood as attempting to convey only the broad general facts.

When it is remembered that our most important and significant acts of will are based upon hopes and fears and beliefs which involve calling upon the memory of our past experience, one begins to appreciate how immensely important for all our life history this memory function of the cortex must be. Thus we choose, for example, one course of action rather than another, because we remember that somebody will be benefited if we act in this way, or injured if we do not. Memory always operates whenever we deliberate, and anything which would deprive us of memory would effectually destroy the will. The cortex of the cerebral hemispheres as the physiological substrate of conscious memory is thus the unquestioned peer among the various gross structures in the nervous system.

The Cerebral Cortex and the Lower Centres.—Experiments on certain of the lower animals, for instance frogs, indicate that with them there is a rather extreme differentiation of function, such that after removal of the higher centres, the lower centres (like the medulla, the cerebellum, and the optic lobes), enjoy an almost complete control over certain special coördinations, one directing the movements made in croaking, another those of turning over and still another those of jumping. These movements are carried out with considerable accuracy in response to appropriate sensory stimulation. On this analogy it is sometimes said that the cerebral cortex of man acts simply as a general overlord receiving information from the senses and issuing commands to the motor underlings who then execute them. This metaphor is accurate enough, if it be not supposed that in man these lower centres are as independent as in the animals. The development of man's nervous system has been accompanied by a certain loss of autonomy and independence in these lower centres which are apparently unable to dispense entirely with the controlling influences of cortical action. Crucial evidence on the matter is difficult to obtain, because man cannot survive the loss of the higher centres.

Important Features of Cortical Action.—In concluding this statement, two things should be emphasised. (1) The cortex is nowhere in direct connection with a sense organ, but receives all its sensory stimulations through the intermediation of the peripheral neurones and of some of the subcortical groups, like the thalami, the medulla and the olfactory bulb. (The olfactory pathways possess certain peculiarities which cannot be fully described here.) The cortex is similarly in direct connection with no voluntary muscles, but communicates with them by means of the subcortical neurones. The shortest possible pathways which could, so far as is now known, be employed in the transmission of an auditory or visual stimulus to the cortex, and back from the cortex to voluntary muscles, is shown in figure 28. The anatomical arrangements peculiar to these illustrative cases may be regarded as typical (save in the case of the olfactory tract; see figures 28 and 29) for all

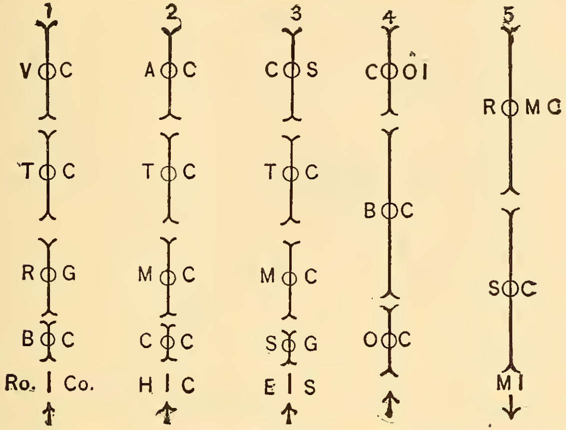

FIG. 28. Diagram to illustrate the shortest pathways from sense organs to cortex, and from cortex to muscles.

Taking the skin nerves as an example of the sensory pathways we find, first, an end-organ in the skin, then a cell in the ganglion outside the spinal cord sending a fibre out to the end-organ and another into the cord. [This is the *sensory neurone* of the functional classification, the *peripheral neurone* of the anatomical classification.] The next neurone has its cell-body in the medulla and communicates with one located in the thalamic region, which in turn communicates with a cell in the cerebral cortex, thus completing the chain from skin to cerebrum. Passing downward from the motor centres we find a long fibre extending through the so-called pyramidal pathway (of which the principal crossed tract is shown in Figure 24) and terminating somewhere in the grey matter of the anterior horn of the spinal cord, where it communicates with another neurone which sends out a fibre to a muscle. [The cell originating in the medullic region in the ascending pathway, together with that in the thalamic region and the descending motor neurone in the spinal cord, belong to the subcortical group of the anatomical classification and, with the exception of the motor neurone, to the *central neurones* of the functional classification. The *cortical* neurones of the anatomical classification also belong to the *central* group of the other classification.] A similar arrangement obtains in the case of certain of the muscles of the head, such as the ocular muscles, for example, where, however, the immediately controlling neurones issue not from the spinal cord, but sense organs and voluntary muscles, but the pathways generally traversed by nervous impulses are probably much more complicated and indirect.

(2) The cortex seems always to act in an essentially unitary way. Consciousness is, then, the counterpart of the total mass of shifting tensions going on all over the cortex at any given moment. When this tension is greatest in the occipital region, we are aware of visual qualities. When the temporal convolutions are under greatest strain, consciousness is auditory, etc. Moreover, in this picture of consciousness as the counterpart of a unified series of physiological tensions all over the cortex, we must not forget that the whole nervous system is in a measure involved. These tensions are of such a character as to require a constant escapement through the motor pathways, with a momentary establishment of equilibrium as a consequence of such escapement, and a fresh disturbance of equilibrium as a secondary consequence; this latter disturbance being brought about through movements actually executed. Such a recurrent series of movements and sensations, illustrated by the accompanying diagram, is involved in every coherent, consecutive occupation of which we are capable. (Figure 30.) Sleep

from the brain stem. With this explanation and the legend which follows the diagram will be easily understood.

1, the visual tract; *2*, the auditory tract; *3*, a cutaneous tract; *4*, an olfactory tract different in character from other sensory paths; *5*, a motor tract. *Ro.* and *Co.*, rods and cones; *BC*, bipolar retinal cell; *RG*, large retinal ganglion; *TC*, cell body in the thalamic region; *VC*, cell in the visual cortex of the occipital region. *HC*, hair cell of the cochlea; *CC*, ganglion cell of the cochlea; *MC*, cell in the medulla oblongata; *TC*, as in the visual tract; *AC*, cell in the auditory cortex of the upper temporal region. *ES*, end-organ in the skin; *SG*, cell of the spinal ganglion on the posterior root of the cord; *MC* and *TC* as before; *CS*, sensory cell in the cortex posterior to the Rolandic region. *OC*, olfactory sensory cell in upper part of nasal cavity; *BC*, cell in the olfactory bulb; *COl*, cell in the olfactory cortex of the hippocampal region. *RMC*, motor cell of the Rolandic region; *SC*, motor cell of the ventral horn of the cord, sending down a process to *M*, a muscle.

affords practically the only instance of cessation from these coördinated series of stimulations and movements. Ideational processes are often, of course, interpolated between

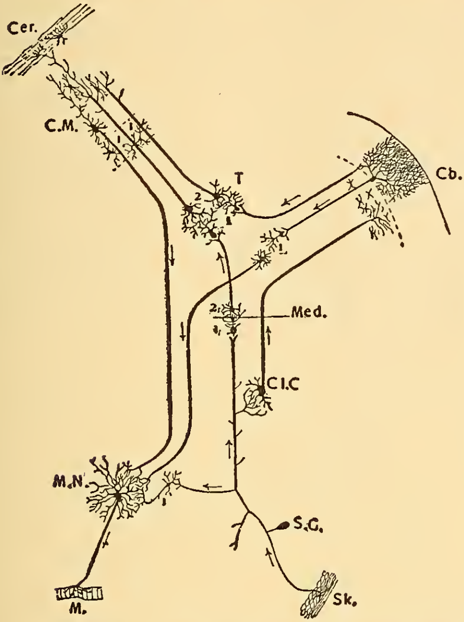

FIG. 29. Diagram to illustrate certain features of the conduction pathways in the nervous system. *Sk.*, a sensory nerve terminating in the skin; *S.G.*, cell in the spinal ganglion, to which the nerve fibre belongs, sending other fibres inward to the spinal cord, where the connections are made with cells above, with others below and still others at the same general level at which it enters the cord. *Cl.C.*, a cell in Clarke's column by means of which impulses may be sent from the skin to the cerebellum. *Med.*, medulla oblongata, where the numbers 1 and 2 indicate respectively a cell by means of which impulses may be sent to adjoining parts of the brain connected with the neurones of the medulla, and a cell by means of which the impulses may be directly transmitted to the cerebral cortex by way of the thalamus, designated by *T.* The numbers 1 and 2 in the thalamic region indicate, as in the case of the medulla, a pathway to adjoining structures and a pathway to the cerebral cortex. Elsewhere in the diagram the number 1 indicates a neurone for branch connections, *e. g.*, in the spinal cord one is shown joining a sensory neurone to a motor neurone. *Cb.*, the cerebellum, which is shown connected with the skin and with the motor neurones, as well as with the cerebral cortex via the thalamus. Other connections of an important character are not represented. *Cer.*, the cerebral cortex. *C.M.*, cortical motor neurone; *M.N.*, motor neurone in the ventral horn of the spinal cord; *M.*, the termination of the motor nerve in a muscle. Arrows indicate the direction of impulses. (Modified from Starr.)

the sensation and the movement, as is suggested by the diagram.

The Autonomic System.—In addition to the *central nervous system* of which we have thus far spoken must be mentioned the *autonomic system* commonly known as the sympathetic system, of which the true sympathetic is a highly important part. The autonomic system, about which our exact knowledge is lamentably defective, is apparently an outgrowth of the central system, and the two are intimately connected, both as regards their structure and their action. Indeed, certain of the autonomic neurones originate in the central nervous system. The striking peculiarity about the autonomic system, is, as its name indicates, its relatively self-directing or automatic activity.

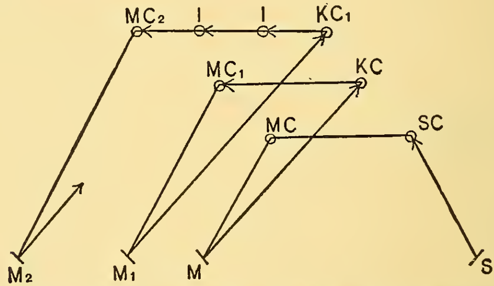

Fig. 30. Diagram to illustrate the progress of a series of coördinated movements. *S*, a sense organ being stimulated; *SC*, the cortical centre for this special sense; *MC*, a motor centre controlling the muscle, *M*; *KC*, a sensory centre for the kinæsthetic sensation produced by the contraction of *M*. MC_1, another motor centre innervating M_1, which in turn produces the kinæsthetic sensory impulse reported at KC_1, etc.; *I*, *I*, ideas or images, whose brain processes may be interpolated anywhere throughout such series, discharging into the motor centre MC_2, thus originating a fresh series of movements and kinæsthetic sensations.

The autonomic system of neurones may be conveniently, though roughly, described as made up of four great groups. One of these groups consists of a series of ganglia gathered into two long strands extending up and down each side of the spinal cord. This contains the sympathetic system in the narrower and more precise sense of the term. (See figure 13.) The second group consists of the great plexuses of ganglia found respectively in the thoracic, abdominal, and pelvic cavities. The third group consists of plexuses or isolated ganglia scattered miscellaneously throughout the body, *e. g.,* in the heart, in the alimentary tract, in the walls of the arteries, in the eye cavity, etc. The fourth group consists of neurones originating in the central nervous system but exercising an autonomic function, as in the case of certain cardiac fibres in the vagus, bladder fibres from the sacral region of the cord and the like. These neurone groups are made up of cell-bodies and fibres for the most part unmedullated. By far the greater portion of the impulses which affect their action apparently come from the central system. They certainly discharge impulses into the glands, the unstriped muscles, and, in the case of the heart, into striped muscle. Thus, for example, when an embarrassing announcement is made in our presence a sensory impulse passes over the auditory tract of the central system and thence, among other consequences, impulses are sent to the region in the medulla which controls the sympathetic ganglia connected with the muscular tissue of the blood-vessels, and straightway we find ourselves blushing. The sweat glands may also become active, causing us to perspire. We become aware of the action of these organs controlled by the autonomic system through the *sensory impulses* which they send back to the cerebral cortex. In blushing the face 'burns,' *i. e.,* the temperature nerves are stimulated and the sensation of warmth results. Similarly, if the heart beat be disturbed, as often occurs in embarrassment, sensations of throbbing or of pain are called forth. The general order of events is accordingly this:

(1) Stimulation of the autonomic neurones, the original stimulus being either inside or outside the organism; (2)

the consequent activity of muscles or glands reported (3) by sensory impulses aroused either directly (as by the heart) or indirectly (as in the cool sensation from the evaporation of perspiration) by such activity.

All the important vegetative and life sustaining processes, such as respiration, circulation, digestion, etc., are under the guidance, partial or entire, of the autonomic nerves. It is consequently to the activity of these parts that we owe our general sense of bodily well-being, as well as our feelings of distress and pain when any of these great life functions go astray. Our consciousness is undoubtedly toned, as it were, all the time by the condition and activity of the organs under the control of the autonomic system. This fact will become very evident when we begin the study of instinct and emotion. The entire nervous system, therefore, and not simply the central system, is concerned in the modifications of consciousness.

CHAPTER III

MIND, NEURAL ACTION AND HABIT

It will greatly facilitate our subsequent understanding of the operations of consciousness if we pause to examine at this point some of the things which the nervous system is able to accomplish without the direct assistance of the mind, together with certain general relations of consciousness to neural action. Such an examination will bring us face to face with one or two of the fundamental principles, or laws, which control neural action.

A Matter of Terminology.—Let it be understood once and for all that wherever we speak, as occasionally we do, as though the mind might in a wholly unique manner step in and bring about changes in the action of the nervous system, we are employing a convenient abbreviation of expression which harmonises with the ordinary everyday methods of thinking and speaking about these relations. The real fact appears to be, as we observed in the previous chapter, that whenever we have mental activity, we have also neural activity in the cerebral cortex. The basal distinction in the two kinds of nervous action to which we are referring in this chapter is, therefore, not primarily between a form in which the mind suddenly produces changes in the nerves as against one in which it does not, but rather a distinction between certain kinds of neural activity overtly involving consciousness, *e. g.*, cortical activity of the cerebrum, and certain other kinds not overtly involving it, *e. g.*, spinal cord reflexes. To use on every occasion the long modifying phrases necessary to precise accuracy on this matter would evidently be unduly cumbrous, and so the commoner modes of expression are employed, but the fundamental facts which lie behind these convenient metaphors must not be forgotten.

Automatic and Reflex Acts.—If we take up the general character of neural action from the genetic point of view, we shall have our attention at once called to the fact that the new-born babe does not come into the world so completely helpless as is sometimes implied. There is a small group of acts which the little stranger is at once able to perform. Respiration, circulation, and digestion are three physiological functions which are carried on from the first. They all involve muscular movements, and constitute what are commonly known as *automatic acts.* The nervous stimulus for such activities is wholly, or in part, *within the organism* itself. Thus, the chemical condition of the blood may be responsible for changes in circulation and respiration, the presence of food in the stomach incites its digestive processes, etc. We are as a rule under normal conditions entirely unconscious of those automatic activities whose effects terminate inside the organism, although if anything goes wrong with them, they ordinarily cause us pain and thus attract our attention.

Other motions can be excited by stimuli *outside the organism.* Thus the sucking movements necessary for the child to obtain its food may be aroused by touching the lips. The fingers will clasp firmly any object put into them, an act said to be reminiscent of the days when our ancestors lived in trees, and the young had to cling to the branches. Acts of this kind are called *reflex.* A reflex act, as we remarked in the previous chapter, is definable as an act in which a movement is made in direct response to a stimulus outside the organism, without the interposition of consciousness. Of course consciousness sometimes takes cognisance of reflex acts, but it does not produce them. We may be conscious that we have winked, and still the closure of the eyelids be due to a reflex. We are very unlikely not to remark that we have sneezed. Oftentimes, however, reflex acts escape our notice altogether, just as the automatic acts do. Reflexes which are entirely unconscious, like that of the change in the size of the pupil of the eye, are called *physiological reflexes.* Those of which we are conscious are called *sensation reflexes.* They represent the transition from non-conscious physiological processes to fully conscious processes. Sensation reflexes can often be suppressed by conscious processes. A sneeze may be checked by a sufficiently vigorous resolution, or by introducing some strong diverting sensation like a loud sound. Physiological reflexes are practically independent of conscious control.

Were we to observe closely the growth of any child, we should find that from time to time new reflexes were added to his original stock. Thus, winking and sneezing would after a time appear, and finally at about twelve or fourteen years of age the full store of these reflexes as displayed by the adult would be complete. This course of development undoubtedly runs parallel to the development of the several nerve centres and the intercommunicating pathways.

Now such acts as these, few in number and simple as they are, evidently furnish the child with a nucleus of coördinations by means of which to begin the conquering of his world. They are evidently hereditary and, as every normal child possesses them, we may regard them unhesitatingly as racial, or phylogenetic, in nature. The animals generally possess at birth a larger equipment of such inherited coördinations than does man, and certain ones we commonly call instincts. These instincts we shall have occasion to examine with greater detail at a later point in the book, so we may pass them by here with the single remark that they are, as regards their origin, undoubtedly akin to the reflexes and the automatic acts. All three are based upon the existence of *congenital pathways* through the neurones of the nervous system by means of which stimulations of one or another kind are enabled to produce appropriate responsive movements. They represent thus the outcropping of the universal racial characteristics in the individual.

Random Spontaneous Movements.—In addition to these relatively well-organised hereditary acts, babies display a great variety of random movements of the muscles of the face, arms and legs made in response to stimulations of every kind. Immediately after birth these movements are comparatively few and feeble, but they rapidly increase both in variety and force. They are sometimes called spontaneous, because they are evidently too variable and erratic to be regarded as reflexes. The term spontaneous must not be understood to carry any definite implication of will and conscious choice. Undoubtedly to the child himself these acts feel at first much like the true reflexes. The earliest movements of this type simply indicate that the nervous system is so constructed as to permit neural excitement to escape over various pathways in a random and miscellaneous manner. The organization of these paths so as to produce efficient acts, constitutes the process of establishing habits and acquiring voluntary control of the muscles, of which we shall have much to say.

Continuous Nature of Organic Activity.—In the light of the foregoing statements it may, perhaps, arouse no special surprise, although it is certainly a striking fact, that from the moment of birth until death there is never complete quiet throughout the organism. Always do we find muscular movements, always something is being done, always activity of some kind is going forward. In sleep itself, which we commonly associate with complete repose, respiration and circulation are occurring, and although each specific muscular contraction is followed by a period of recuperation for that particular muscle, there is never entire quiet throughout the organism as a whole. When awake, these automatic activities are augmented in the new-born child by such reflexes and random movements as we have mentioned. The reflexes naturally occur but infrequently, and as for consciousness, it appears during the first weeks of a child's life only for brief periods, most of the time being devoted to deep sleep. Nevertheless, the points at which it does appear are of fundamental importance for our correct apprehension of its function, and we must examine them with care.

The Appearance of Consciousness.—We obtain a significant clue for our undertaking by noticing at what points consciousness is most actively at work in adult experience—a matter to which we shall repeatedly refer as we proceed in our study. An illustration may serve to clarify the situation.

An expert can use a type-writing machine almost without any conscious guidance of the movements which are necessary to operate it. He has acquired by long practice a set of habits whereby he manipulates the keys. These habits involve, among other things, coördinating the movements of the hand with movements of the eyes, the latter movements being in part reflex, *e. g.*, accommodation of the lens. As the writer proceeds, his mind may be entirely absorbed in the *meaning* of the sentences which he is composing. But if the machinery of the type-writer becomes clogged, the operator must at once direct his attention to the machine, abandoning all thought of the composition. His automatised writing habits are powerless to deal with such a difficulty and they must consequently give way to *conscious* control processes. If the facts of this illustration be typical of general conditions, as the author believes them to be, it may be asserted that consciousness in one or other of its forms normally appears and participates only in such activities as cannot be efficiently executed by the hereditary reflexes and the acquired automatisms. In the light of this conception, suggested by easily ascertainable facts of adult experience, we may interpret the facts of mental development in infancy, to which we necessarily gain a more indirect access. Obviously in the case of the infant there can be at the outset no acquired habits, and it seems reasonable therefore to assume that conscious activities emerge at the point where reflex acts are found inadequate to meet the needs of particular situations.

Evidently the equipment of coördinations with which we have found the new-born infant supplied cannot carry him very far in his adjustment to the complex surroundings amid which he finds himself placed. Why he should have been limited by nature to just the special group of inherited coördinations which we observe in him is a question for the biologist to answer. We cannot at present go behind the facts. But it is clear at once that in the list of muscular activities over which the babe has control, there is no mention of means for responding very effectively to auditory or visual stimuli, to name no others. If the reflexes and the automatic acts were wholly competent to steer the organism throughout its course, there is no reason to suppose that consciousness would ever put in an appearance. Certainly we never find it obtruding itself where these conditions are observed, except in pathological instances. The formulation which has been proposed is intended to apply primarily in a descriptive way to the circumstances under which mental processes actually come to light in human life. The larger explanatory bearings of the formula as well as its applicability to the fundamental question of the genesis of consciousness in animal life are not under discussion at this point.

An Illustration from Hearing.—Let us examine as a typical case what happens when the consciousness of sound first occurs. We know that many children are unable to hear for several days after birth, partly because the middle-ear is filled with mucus. When, however, the ear is able to receive the auditory stimulus, we have at once an excitation of the organism for which there is no definite preformed muscular response. Some children, to be sure, early display a tendency to move the head, as does an adult in localising a sound, and this may possibly be a partially hereditary propensity. But it is problematic whether this ever occurs immediately after birth, and certainly it is quite rare. The usual thing under such conditions is unquestionably the appearance of vague consciousness dominantly of the auditory kind; the stimulation having the tendency, if it be intense, to discharge itself according to the law of "diffusion" (of which more anon) throughout many motor channels, involving random movements of the muscles in various parts of the body.

Now these movements require coördination. If they are ever to be turned to account, they must be controlled and ordered. The new stimulus has broken rudely in upon the coördinated reflex and automatic activities already going on. It has probably affected the circulation and the respiration. If the child were feeding, it may have shocked him into cessation and, in place of the sucking, set up the unwelcome wailing. Such a case is typical of the occasions where consciousness comes to light. The organism has end-organs sensitive to sound stimulations, but no ready-made physiological arrangements for *responding effectively* to such stimuli. Consequently, when a stimulus of sound bursts in upon its activities, some of which, as we have seen, are always in progress, it finds itself helpless and unable to act in any save a random and disordered way. Straightway appears consciousness with its accompanying cortical activities, taking note of the nature of the stimulus and of the various kinds of muscular response which it called forth. From this point on, the development toward the attainment of those fixed and intelligent modes of reaction, which we call habits, is steady and uninterrupted.

Were we to take time for a thorough exploration of all the sensory forms of consciousness, *e. g.*, vision, taste, smell, touch etc., we should find that they are all called forth under the same conditions of inadequacy on the part of the purely hereditary physiological mechanisms of movement, to meet the demand of the physical and social environment.

The Formation of Habits.—It shall be our next business to trace in outline the process by which consciousness and the brain bring order out of this threatened chaos and leave the organism a group of habits to which additions are continually made and by means of which the organism becomes increasingly master of the situation. This account will be only a sketch, however, for all the rest of our study will really be devoted to filling in the details. In the chapters upon volition we shall return specifically to these very points.

A. Fundamental Facts of Nervous Action.—It will be remembered that in the previous chapter, when studying the nervous system, we observed that in its simplest forms the nervous organism appeared to be little more than a device to connect a sense organ with a muscle and so to enable the discharge of movements in response to stimulation. When we examined complex systems, like that of man, where memory processes are clearly in evidence, we noticed that this same principle was everywhere in evidence, although it gained its expression through the most elaborate arrangements in the nervous tissues. We remarked, also, that the normal fate of every incoming sensory stimulus was to find its way out again sooner or later in the form of muscular movements and glandular activities. This tendency is in no way modified by the complexity of the neural structure, except as regards the ease with which we detect such reappearance of the stimulus in the form of motion. If we bear these facts in mind, a considerable part of the mystery seemingly surrounding the processes we are now to investigate will fall away at the outset.

B. (1) Excess Movements—The Beginning of Motor Control.—Let us take as a typical instance of the development of motor control the series of events which occur when a baby first learns to connect a visual impression with a movement of his hand and arm. Suppose a bright, coloured ball is held before his eyes. This stimulus sends strong sensory currents over the optic tracts to the brain centres and somehow or other, as we have seen, these currents must get out again in the form of movements. But we have also seen that there are few or no preformed reflex pathways over which such neural excitement may be effectively discharged. Certainly there are none which enable the child to bring about changes in the stimulus, and this is commonly the important thing. Consequently, instead of some single relatively simple movement like that of reaching, we observe precisely what the principle of "diffusion" postulates as normal, *i. e.*, a mass of aimless, uncoördinated movements in a large number of muscles. The face is wrinkled in a frown or a smile, as the case may be, the fingers open and shut, the arms jerk about, the body and legs move spasmodically and possibly the child cries out. This does not seem a very promising beginning for the development of intelligent control, and yet in point of fact it contains just the features most essential for progress. Speaking generally, we may say that such stimulations call out an *excess reaction,* a motor response in which are contained, almost without fail, the special small groups of useful and important movements which subsequently become isolated from the general miscellaneous motor matrix in which they at first appear. We can detect the manner in which this result is attained by observing our illustrative baby still further in the light of our knowledge of how we, as adults, acquire new coördinations.

Presently, if the stimulus be made more exciting by moving it to and fro, some of these excess movements of the arms will result in the child's hand coming into contact with the ball. We have already noted the hereditary clasping reflex, and we shall not be surprised, then, to find that the tactual stimulus to the skin of the hand results in the closing of the fingers. Now undoubtedly this first successful grasping of the seen object may be wholly accidental, in the sense that it is wholly unforeseen by the child. He is much more surprised by the occurrence than any of his interested observers, who accredit him with a wealth of conscious purpose and intention of which he is completely innocent. But let us observe what fundamental consequences are bound up with this success.

(2) **Agreeable and Intense Character of Accidental Successful Movements.**—To begin with, the mere shock of surprise and (generally) pleasure makes the connection of the tactual-motor sensations from his hand with the visual sensations from his eye extremely vivid. As he moves his hand, he finds that his visual impressions change. When his hand comes to rest, his visual object also remains quiet. There is no reason to suppose that the child is in any definitely reflective way aware of these things. He does not say to himself: "When I see my hand move, I see the ball move; therefore, the two things are connected in some way." Indeed, it is probably impossible for us in adult life to portray accurately to ourselves the simple immediacy of such experiences as these in infant life. But the important point, after all, is this, that of all the sensations which his whole acquaintance with the ball has brought the child up to this point, the ones connected with his seeing it when he grasps it, and his *seeing it change* when his arm-and-hand-feeling changed, are the ones most intensely connected in his consciousness.

If we read backward into his mind, then, what we all know about our own adult experiences, we may be sure that the child's organism is extremely likely to retain the memory of the highly vivid connection between the visual sensations of the ball and these tactual-motor feelings which accompanied the successful grasping of it. Moreover, the genuineness of this connection is indicated by the evident tendency to make the successful kind of arm movement, rather than any of the dozens of other movements with which he started his response to the ball, provided we give him at once an opportunity to get again the same visual impression from which he set out. To be sure, many of the irrelevant movements persist for a time, but they rapidly become less frequent and finally disappear. The perfect result is of course rarely attained without many trials. In this way, however, the child speedily does for himself what nature did in the case of the reflexes, *i. e.,* gives himself a neural pathway through which sensory impulses may flow out over motor channels for the production of effective coördinated muscular movements. In this case we have observed the establishing of a control connection between eye and hand. The sight of the ball will henceforth tend to call out the appropriate reaching and grasping movement.

(3) **The Inhibition of Useless Movements.**— The more firmly this connection becomes established, and the more deeply the pathway is cut between the visual sensory centres and the hand-arm motor centres, the more do the irrelevant movements of face, legs, and body tend to drop away. They are inhibited, as we say. Probably this inhibition is in largest measure due to the fact that the newly formed channel is increasingly able to carry off all the neural excitation, and in consequence less remains to overflow into other channels. But the result is certainly beyond question, whatever the means by which it is attained. Moreover, just in proportion as any such coördination becomes perfect, consciousness tends to drop out of the supervision altogether, and to turn the process over to the purely physiological mechanisms of the organism. Figure 31 illustrates certain of the relations which have been described.

The Attainment and Retention of Modifications in the Nervous System.—The nervous system is not only sensitive to the various forms of stimulation which we call light, sound, temperature, etc., it also manages in some way or other, as we have already observed, to store up the modifications which the stimulations produce in it. These modifications which are thus preserved manifest themselves in the disposition of nervous impulses to run in the same channel which predecessors have cut out. If the nervous system were an inanimate mass, we might liken that which occurs to the process by which a path is made across a meadow. The first wayfarer may have selected his special route for any cause

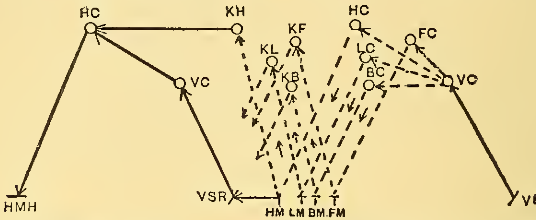

Fig. 31. Diagram to illustrate the establishment of motor control through the principle of "excess discharge." *VS*, visual stimulus setting up excitation in the retina, which transmits it to *VC*, visual centre in the occipital cortex. Thence the neural excitement overflows into *FC*, motor cells controlling muscles of the face, *BC*, motor cells controlling muscles of the body, *LC*, motor cells controlling the legs, and *HC*, motor cells governing the hand and arm. *FC*, *BC*, *LC*, and *HC*, all discharge into their connected muscles, *FM*, *BM*, *LM*, and *HM*, and each muscular contraction sets up kinæsthetic sensations, *KF*, *KB*, *KL*, and *KH*. Of all the movements made, *HM* alone affects the stimulus *VS*. *VSR* represents the stimulus reinforced by being moved by the hand. This intensifying of the factors *VC*, *HC*, *HM*, and the connected factor *KH*, renders the pathway from *VS* through *VC*, *HC*, to *HM* more pervious than any of the other possible pathways. Consequently the tendency gets fixed for *VS*, or its connected cortical processes *VC* and *KH*, to discharge into the appropriate grasping movement, *HMH*.

whatsoever, and his course may have been devious, like those of the cows which are said to have laid out the streets of Boston. But he has left a mark in the downtrodden grass, which the next person to cross the field is likely to follow. Presently the grass is wholly worn away, and thereafter everyone follows the beaten path.

The action of nervous impulses is often spoken of as though this kind of thing were precisely what happened. But the moment we recall the fact that the nervous system is part of a living organism, in which processes of nutrition and repair are constantly going forward, and when we remember, furthermore, that the organism itself can in large measure decide whether a stimulus shall be experienced again and whether a movement shall be repeated or not, we see that the metaphor of the pathway in the meadow must be abandoned in favour of some idea in which the vital processes of the organism are recognized and the living tissues treated as something other than so much static, plastic clay, which the accidents of the external world can mould to their own exclusive purposes. It is undoubtedly true that when avenues, or channels, of nervous activity become once established, they tend ever after to remain and be employed. But the point which we must emphasise is, that the organism itself largely decides which pathways shall in the first instance become thus established. When one recalls the large number of sense organs on the one hand, and the large number of muscles on the other, between which the central nervous system affords connections, it will at once be appreciated that, if the establishment of dominant connections in the new-born child were left to the accidents of the first external stimulations and to the vagaries of merely passive nervous centres, the chances would favour the acquirement of insane and harmful habits of reaction. Objects which burn would be just as likely to produce movements of grasping as movements of retreat.

We may summarise the general purport of habit as a fundamental principle of nervous action in two propositions. (1) Nervous currents tend to employ those pathways which have been previously established. (2) The organism itself plays a governing part in determining what pathways shall become thus fixed.

The Mechanism of Established Habits.—When an habitual coördination becomes thoroughly ingrained, it seems, as we have repeatedly remarked, to become almost reflex and to dispense wholly with conscious guidance. A skillful telegrapher can largely abandon over-sight of his hand in sending familiar forms of messages. A musician can play familiar scores while carrying on a conversation. Many of us can write common words although absorbed in some other mental occupation. We can walk long distances while deeply engaged in reflection and apparently quite inattentive to the muscular movements we are making. To be sure, it is difficult to prove conclusively that under such circumstances we are ever absolutely oblivious to our muscular activities; but to all practical intent we are surely often entirely preoccupied with other things and still are able effectively to carry on habitual acts.

A widely accepted account of the mechanism of the process maintains that what occurs is represented by the following diagram. (Figure 32.) The act—suppose it to be a writing movement—is started either by an idea or a sensation. Forthwith, the first of a chain of revelant movements occurs, perhaps in this instance the downward stroke of the pen. This movement is reported by sensations from the muscles, joints and tendons of the hand and arm. These sensory stimulations which in turn instigate succeeding movements, go on till the act is complete, or until the will steps in and stops the performance.

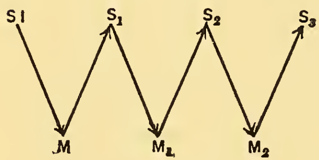

FIGURE 32.

This description is probably roughly correct, but it presents far too simple and diagrammatic a picture to be taken literally. Experiments show that in such cases as writing illustrates, the sensory cues which are involved come from the eye and even the ear quite as often as from the muscles and joints. They show, too, that ideas, as distinct from sensations, often play an important part, and that there is the utmost variation from person to person, and in the same person under different conditions, as to what sensory and ideational material is used. But that orderly muscular movements follow immediately upon cues which have been organized into these habitual groupings, that the cues follow promptly upon the previous movement, and furthermore, that the cues are often of an essentially physiological and non-mental character, may be regarded as certain. So far as the diagram indicates these facts it is correct.

Results of Habit.—The advantages which accrue from habit are mostly self-evident. When we compare such habitual coördinations as are involved in writing the familiar English script with those employed in writing the German characters with which most of us are far less familiar, we note that the former letters are much more rapidly executed, that they are much more accurately made, and that they produce far less fatigue. It is evident, therefore, that habit is a most valuable contributor to efficiency in action. Any process which increases speed and accuracy, while at the same time it diminishes the fatigue of labour, is a possession to be cherished.

But more important, if possible, than any of these results is the fact that through the mediation of habits the physiological organism is enabled to cope almost unaided with situations which originally required the assistance of conscious processes, and consciousness is thus left free to go about further attainments, which will in their turn become habits and be handed over to certain of the relatively non-conscious processes of the nervous system. Mind is thus ever going on in advance and building up coördinations, which are necessary to the most effective reactions upon the environment. The whole course of mental development could truly enough be described as made up of this process of acquiring habits, which once imbedded in the tissues of the nervous system become the permanent possession of the individual, ready, when need arises, to step in and deal with the necessities of any particular situation. Moreover, development usually ceases whenever the necessity for further nicety of adaptation to surroundings is no longer definitely felt.

This is undoubtedly the reason why various habits settle down on us permanently at certain ages. Many bodily habits, *e. g.,* habits of personal cleanliness, are substantially fixed during childhood, likewise such nervous habits as biting the finger nails. One's manners and standards of dress, one's mode of enunciation and tone of voice are commonly determined during adolescence, as well as one's general moral and religious habits. Professional habits are naturally acquired somewhat later and are ordinarily more mobile than the others mentioned, with the possible exception of the moral and religious group. The lawyer, physician, priest, teacher, bank clerk, book agent and day laborer has each his characteristic gestures, attitudes and habits of thought which mark him distinctly in the eyes of the expert. If we make essential and radical changes in any of these fundamental habits, it is because of some change in our circumstances which renders us sensitive to the need for readjustment.

Innate Hereditary Acts and Acquired Habits.—If we now look back over the ground covered in this chapter, we shall see that consciousness occupies a curious middle-ground between hereditary reflex and automatic activities upon the one hand and acquired habitual activities upon the other. The organism comes into the world with a small capital of these hereditary coördinations. These suffice to meet the most immediate and pressing needs in the conservation of life, but they are hopelessly defective for the attainment of anything beyond these immediate necessities. Now and again the world of light and sound and contact breaks in upon the coördinations which our hereditary neural mechanisms are executing, because the adaptive responses made by these mechanisms are inadequate to the organic necessities of the situation, and at such points we find consciousness appearing. Consciousness immediately enters upon its characteristic cycle. At first of course its activities are vague and crude. But presently we find selected from out the masses of motor responses created by the sensory stimulations to which the sense organs are sensitive, those particular ones which issue in effective muscular control over the environment, and straightway we are confronted with habits. As soon as these habits are firmly established, consciousness betakes itself elsewhere to points where habitual accommodatory movements are as yet wanting and needed.

It is an interesting fact incidental to this development, that when we attempt to inject consciousness into a process which is either reflex or habitual, we upset the accuracy of the coördination and mutilate its efficiency. Thus, to direct attention to the act of swallowing, which is a reflex, is to render it for many persons all but impossible of performance. Witness the common difficulty in taking pills. Similiarly, to direct attention to one's mode of walking often results in producing a thoroughly artificial gait quite unlike one's normal manner. The early experiences of appearance before the public, as on the stage, illustrate the point. They also suggest the practical wisdom, if one would avoid embarrassment and failure on such occasions, of concentrating attention as completely as possible on the task in hand, throwing oneself wholly into it, so that there may be no mental energy left over to put on one's own bodily status.

Habit and Will.—Although we do not commonly think of it in this way, a moment's reflection will show us that all expression of the will depends upon our ability to command habitual muscular coördinations. For example, I decide after careful consideration that duty bids me refuse a friend's request. Now note, that if I speak to my friend, I must fall back upon habits of articulation, which cost me much labour as a child to attain, but which now largely take care of themselves. If I decide to write my decision, again I must employ habitual activities, and I cannot by any device communicate intelligibly with my friend without employing these or other similar muscular movements which are essentially habits. Neural habit, therefore, is not only the great emancipator of consciousness from the necessities of endless control over the same trivial round of acts, it is the great tool by which that feature of the mind which we call the will executes its behests and renders our mental decisions and choices effective in the world of action. Without habits, consciousness could never get beyond the borders of the inevitable daily routine. With habit, however, it is able to pass from victory to victory, leaving behind in captivity the special coördinations it needs.

Intellectual Habits.—We cannot linger to develop the matter, but it may be helpful simply to point out that the assimilation of any subject matter, such as mathematics, for instance, involves a precisely similar establishment of habits, which, as the material is thoroughly mastered, are left behind for use when required. We do not ordinarily regard such attainments as concerned in any fundamental manner with muscular movements, although we all recognise readily enough that the sole manner of assuring ourselves a reliable command over a subject matter is to use it, to *do* something with it. We sometimes think of such *doing* as purely mental. In reality, however, movements are involved in all cases, and, even were this not true, the general principle of habit, so far as this stands for a law governing the transmission of nervous currents, would still be valid. The gain in rapidity, efficiency, and lessened fatigue would remain, not to mention the freeing of consciousness for further achievements.

Apart from such command over special departments of information, what are known as "habits of thought," which we are often vaguely told we ought to cultivate, are in reality largely habits of exercising our attention. We are assured, for instance, that the pursuit of certain studies is valuable because it will teach us desirable habits of thought. Now when this assurance means anything more than the expression of a pious hope, it refers either to the attainment of a familiarity bordering on habit, with a useful field of information, or to the securing of general modes of approaching a new subject matter; habits of alert attention, habits of logical division and persistent search for relations, etc. Whether any special studies are preëminently valuable in the production of this second class of results is a question which can be answered more judiciously, if at all, at the end of this book. Meantime, we shall not err seriously if we assert that a wholly fallacious value has often been placed upon so-called formal disciplines, which are supposed to teach us how to do things in general, without any special reference to accomplishing particular results.

Ethical Aspects of Habit.—The moment one gets clearly in mind the physiological nature of habit and its basis in the nervous tissues, its ominous significance for morality becomes evident. To break up a bad habit means not only to secure a penitent, reformatory attitude of mind,—this is often easy to achieve,—it means a complete change in certain parts of the nervous system, and this is frequently a thing of utmost difficulty of attainment. No amount of good resolution can possibly wipe out at once the influences of nervous habits of long standing, and if these habits be pernicious, the slavery of the victim is sure to be pitiable and likely to be permanent. On the other hand, the momentous significance for the individual and society of deeply imbedded habits of a moral kind cannot be overestimated. The existence of such habits means stability, reliability, and a promise of the utmost possible confidence. It is all but impossible for one to break over the moral habits of a lifetime. One may at times be mildly tempted by the possibilities such breaches hold out, but actual violation in overt action is essentially impossible. The man who has been vicious all his life is hardly free to become virtuous, and the virtuous man is in a kind of bondage to righteousness. What one of us could go out upon the street and murder the first person we met? Such action is literally impossible for us, so long as we retain our sanity.

In view of these considerations, no one can over-estimate the ethical importance of habit. To make of the body, in which our habits are conserved, a friend and ally and not an enemy, is an ideal which should be strenuously and intelligently held out to every young person. One never can say at what precise moment it may become literally impossible to shake off a bad habit. But we know with perfect certainty that our nervous tissues are storing up every day the results of our actions, and the time is, therefore, sure to come when no amount of merely pious intention can redeem us from the penalty of our folly. Meantime, for one who has fallen under the sway of a habit from which he wishes to escape, this general advice may be given: begin the new régime at once, do not wait for a convenient season. If the result be not likely to be physically disastrous, stop wholly, do not taper off. Give yourself surroundings which will offer the least possible temptation. Do not try merely to suppress the bad habit. If possible, put something else which is good in place of it. See to it that you are always occupied in some proper way until you feel sure that the grip of the bad habit is loosened.

It is to be frankly admitted that viewed in a broad way the benefits of habit have their limitation. If the world always did things just as they have been done in the past our civilisation would approach that of the Chinese. But the changes which by the consensus of intelligent persons are beneficial to mankind, the alterations of habit which are progressive, are rarely such as have to do with those purely personal forms of action whose perversion constitutes the most flagrant form of vice.

Moral progress always consists in a harmonised action of wider and wider interests, the securing of broader and truer visions of life. Such progress, while it may change old and accepted habits of life, does not for a moment involve any departure from those rules of personal honesty, sobriety, and chastity which the world's history has demonstrated again and again to be foundations of all sane, happy, human life.

CHAPTER IV

ATTENTION, DISCRIMINATION, AND ASSOCIATION

I. ATTENTION

Consciousness and Attention.—We announced our purpose at the outset to adopt a biological point of view in our psychological study, and to attempt at every step to see just how the mind aids in the adjustment of the human being to the environment. If we turn from the merely general statement that the fundamental function of consciousness is to better such adaptive activities, and observe any specific instances of the process of adaptation itself, we shall always find that the actual work of accommodation is going on at the point which we call the point of attention. Attention, we shall accordingly discover, represents the very heart of conscious activity, its most important centre of vitality. It therefore deserves our careful notice.

In a vague fashion we all recognize this rudimentary significance of attention. Thus we speak of the awakening of the new-born infant's mind when we first see signs that the child is attending to something. Moreover, we roughly measure the growth of children in intellectual maturity and power by their increasing ability to give prolonged attention to definite trains of thought. Alienists and specialists in nervous disorders inform us that mental disease is commonly accompanied by disturbance in the power of attention. In some forms of neurasthenia the attention is extremely unstable and irritable, flitting from one subject to another with feverish haste. In mania there is often a similar, but much exaggerated, attention to the flow of disconnected ideas. In melancholia, on the other hand, as in the milder types of neurasthenic hypochondria, attention is morbidly fascinated by some single idea, or group of ideas, and cannot be long lured away to the normal business of life.

Definition of Attention.—When we attempt a definition of attention we experience the same sort of difficulty which we met in defining consciousness, and for a similar reason. So long as we are conscious at all, attention in some degree is present. We therefore find it difficult to define it without employing the thing itself in the definition. Because of this fact, attention has been commonly referred to as a 'general, or universal, characteristic of consciousness,' or as a 'general attitude,' especially as an attitude of expectancy. In default of a wholly satisfactory definition of attention, we may at least illustrate what we mean by the term. When we look at a printed page there is always some one portion of it, perhaps a word, which we see more clearly than we do the rest; and out beyond the margin of the page we are still conscious of objects which we see only in a very imperfect way. The field of consciousness is apparently like this visual field. There is always a central point of which we are momentarily more vividly conscious than of anything else. Fading gradually away from this point into vaguer and vaguer consciousness, is a margin of objects, or ideas, of which we are aware in a sort of mental indirect vision. *This fact that consciousness always has a focal point, which reveals the momentary activity of the mind, is what is meant by the fact of attention,* so far as it can be described in terms of the *content* of consciousness. Baldwin has suggested the accompanying diagrammatic presentation of the facts we are speaking of, in connection with certain others. (Figure 33.) The margin of mental processes, outside the focal point of attention, constitutes what James calls the "fringe of consciousness." Whether we are attending to objects in the world about us, or to ideas in our own minds, there is always such a fringe, partly made up of sensations, partly of ideas. No matter what we are especially attending to, we are never completely oblivious to all other sensory and ideational processes.

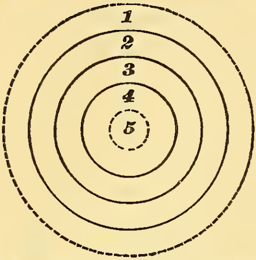

FIG. 33. Graphic representation of the field of consciousness. *1*, the unconscious (physiological); *2*, the subconscious, by many psychologists not distinguished from *1*; *3*, diffused, vague consciousness; *4*, more active and distinct consciousness, often not distinguished from *5*, the focal point of attention. The several zones shade into one another and are by no means sharply separated, as the lines of the diagram unfortunately suggest. (After Baldwin.)

Sensations and thoughts to which we attend commonly occupy consciousness longer and more steadily and are ordinarily clearer and more intense than the remainder of the field. Thus, if we give our definite attention to a musical note we remark its exact quality much more perfectly than when we simply listen to it in a casual way. It is apt to seem more intense, and it certainly tends to linger longer in the mind. Statements of this kind bring out the fact that we use the term attention at times as virtually synonymous with mental activity, and it is this point of view which justifies us in speaking of *directing the attention* to an object or to any part of the field of consciousness. To turn the attention to an object is simply to direct one's mental activity toward it. Now, our mental activity, considered as directive, is commonly called conation, and we must accordingly conclude *that attention is a rudimentary form of conation, or will.* This is unquestionably true.

We see, then, that attention is capable of being considered in two different ways. We may emphasise the mere fact of *mental activity,* illustrated by all attending; or we may dwell upon the *structure* of any moment of such attentive consciousness, and note the fact of its containing a focal point, with a fading margin. But our emphasis upon one or other of these phases of attention does not alter the fact that the mental process, which we describe in these two ways, is one and the same. In the remainder of the chapter we shall therefore make no attempt rigidly to dissever these aspects of every act of attention, although we shall be frankly most interested in attention as an instance of mental activity. Meanwhile, the best practical definition of attention is afforded by such an analysis and description of it as is contained in the remainder of this chapter.

Selective Activities Disclosed in Attention.—Probably the most striking characteristic of acts of attention is their selective nature, and the significance of this function will grow more conspicuous as we examine the facts. We have seen that the nervous system is so constituted that by means of its sense organs it is capable of being affected by various forms of motion in the physical world, *e. g.,* light, heat, sound, etc. This fact has itself sometimes been regarded as a form of cosmic, or organic selection. Thus, of all the rates of vibration in the physical world, the normal retina responds only to those between the limits of approximately 440 trillions and 790 trillions per second. In a similar way the ear selects a certain group of sound vibrations, and so on for the other senses. Undoubtedly there are many forms of vibrations in the physical world to which we are either partially or wholly insensitive, because we have no sense organs appropriately attuned to their special rates, and are thus incapable of receiving them. The X-ray and magnetic currents afford illustrations of such physical phenomena.

However all this may be, it is easy to convince oneself that innumerable stimulations of the kind to which we *are* sensitive are always falling upon the sense organs; and were we conscious of all of them at once our minds would present a curious conglomerate. As a matter of fact, only a few of these stimuli ever succeed in producing simultaneously that form of cortical reaction which accompanies consciousness, and consequently we are never at any one moment aware of more than a small part of them. Apparently the psychophysical organism selects from the wide range of potential objects those special ones which shall receive attention and so come to consciousness. Thus, when reading an entertaining book we may become altogether oblivious to the rattling of carts in the street, to the odour of the smoking lamp, to the contact sensations from our clothing, etc. Similarly, when we are preoccupied with some train of thought, our attention dwells upon this idea, and turns away from that, according as the one or the other appears to the mind to be relevant and useful for the business in hand. One and the same *physical* object may be attended to in various ways, so that it becomes *mentally* several different objects. For instance, the top of my desk is one thing when I give it my attention in the search for a mislaid paper. It is quite another thing when I attend to it in order to determine of what wood it is made, and it changes once again if I attend to it to discover whether it can be moved through a certain narrow door. Indeed, were it not for the selective activities exercised in the form of reasoning, it is clear that we could never make any consistent mental advance, but that we should always be at the mercy of our sporadic ideas. We can, perhaps, examine this selective function of attention to best advantage by analysing the principal forms in which attention is found to operate.

Forms of Attention.—Probably the most fundamental division of attentive processes, and certainly one of the oldest, is that into active and passive, or, as they are better termed, voluntary and involuntary attention. A more satisfactory division, which we shall adopt, adds one more class, and recognises (A) voluntary, (B) non-voluntary, or spontaneous, and (C) involuntary attention.

A. Voluntary Attention.—Active, or voluntary, attention is precisely what the name implies, attention as the result of definitely self-initiated activity. In its clearest and most unambiguous form it always involves mental strain and effort. Whenever we attend to anything because we explicitly will to, we are exercising voluntary attention. It matters not what the object may be to which our minds are thus directed. It may be a sound or an odour, an object which we see, or an object which we touch; a thought in the mind itself, a memory, an emotion, or anything one pleases. So long as it is attended to, as the result of our definite purpose to give it attention, it must be regarded as involving a case of voluntary attention.

That we are capable, within certain limits, of thus directing our mental activity wherever we will is one of the easiest of facts to verify introspectively. Probably the reader has found repeated occasion, before reaching the present point in this book, to make just such voluntary efforts of attention to prevent his mind from wandering off to more attractive by-paths. Obviously the selective function upon which we have already insisted so strongly, is conspicuously in evidence in active attention. Moreover, it seems probable that this type of attention, involving, as it does, the purposeful direction of our thoughts, would in its fully developed form be a somewhat later achievement than the other forms, which require for their existence far less of experience. To *direct* one's thought involves the possession of purposes and plans, however rudimentary, and these are the outgrowth of experience and relative maturity. Young infants are hardly capable of voluntary attention in any proper sense, although they may achieve both non-voluntary and involuntary attention from the beginning.

B. Non-Voluntary Attention.—It requires no extended reflection upon our everyday experience to reveal to us the fact that in the course of every twenty-four hours we attend in an effortless way to a great many things to which we have no explicit purpose to direct our thought, to which we cannot, therefore, be said to attend voluntarily in the full sense of the word; but to which we certainly are not attending *against* our will and in *spite* of ourselves. Such cases constitute what is meant by non-voluntary, or spontaneous, attention. A few illustrations may make the distinction clearer.

It happens not infrequently, for example, that we suddenly arouse to consciousness of the fact that for several minutes our minds have been running off on subjects quite disconnected from the special occupation with which we may at the moment be engaged. We have "lost ourselves," as we say, in some day dream, perhaps. Our prolonged attention to a subject which sincerely interests us is often of this same character. Our attention is not given as the result of any effort on our part. Rather should we find that it required effort to direct our attention elsewhere. It necessitates no strenuous act of will for the boy interested in athletics to give his attention to a newspaper account of a football game. On the contrary, his attention can only be obtained for less exciting themes by some artifice on your part, or by a self-sacrificing effort of volition upon his.

The attempt has often been made to specify the objects to which we naturally attend in this spontaneous way. Other things equal we seem to attend by preference to intense stimulations, to objects which produce pleasure, to moving things, to persons and animals, and in general to everything which elicits emotion. Such a list has, however, little more than a rough suggestive value. It requires to be qualified in many important particulars before it can be accepted unequivocally.

So far as these cases of non-voluntary attention reflect the actual nature of our interests, they must be regarded as affording peculiarly intimate information of the real character of our minds, and so of our wills. They are thus, in this particular, closely related to voluntary attention. After all, what I am interested in is a very close synonym for what mentally and morally I am.

C. Involuntary Attention.—However genuinely voluntary and non-voluntary attention may differ from one another, they neither of them involve attention given *against* the will. But there are numerous cases in which, at first sight, anyhow, this form of attention apparently occurs; and it is to this that the name "involuntary attention" has been given. Thus, for example, if the door slams while I am writing this sentence, I am seemingly obliged to hear the sound, however much I might prefer not to do so. To be sure, if I am sufficiently preoccupied a very loud noise may in this way escape my notice; and the obliviousness to ordinary sounds, such as the ringing of the dinner-bell, the striking of the clock, etc., of persons thus engrossed in some interesting occupation is too familiar to require comment. Even severe wounds may under such conditions go unnoticed. Archimedes, absorbed in his studies and unconscious of the sacking of Syracuse, is the classical illustration of this kind of thing.

But despite the fact that when one is thoroughly immersed in some congenial undertaking one becomes relatively insensitive to sensory stimuli, which otherwise would be noticed, the further fact obstinately remains that even under such conditions stimuli of sufficient intensity *will* force themselves into consciousness. Certainly we should all agree that in this way bright flashes of light, loud sounds, unpleasant odours, etc., repeatedly intrude themselves upon our attention distinctly against our wills. Moreover, there are experiences in which ideas, instead of sense impressions, thus force themselves in upon our attention against our wills. What are known as insistent ideas are of this character. The hypochondriac, for instance, is unable long to keep his attention away from his own bodily ailments, real or fancied. He may make a sincere effort to divert his mind, but in spite of himself the unwelcome idea presently shows its face at the door and claims his recognition.

Less definitely morbid than such cases, and still illustrative of the imperious command exercised at times over our attention by certain ideas, are the intense experiences of the emotional kind. Great joy, great grief, great anxiety, brook no prolonged opposition. We may attempt to force our attention on to the lines of the day's work and for a moment succeed, only to find ourselves in the next moment once more mastered by the idea we had attempted to put behind us. Certain psychologists would prefer not to give the name involuntary attention to these cases of attention against the will to ideas. But they are clearly more closely related to this form of attention, as illustrated by our forced attention to intense sensory excitation, than they are to the other classes we have distinguished; and we shall accordingly designate them as cases of involuntary attention.

Interrelations of the Forms of Attention.—We have already intimated that involuntary and non-voluntary, or spontaneous, attention are genetically prior to voluntary attention. Undoubtedly the earliest experiences of a baby involve in largest measure spontaneous attention to sensory stimuli. The rude power with which some of these stimulations force themselves on the child's notice might give ground for the postulation of involuntary attention also. But if we confine the term "involuntary attention" strictly to such cases as those in which we attend against our wills, it is doubtful whether we ought often to apply the designation to a young child's attention; for we can hardly speak with confidence of the newborn child's possessing any resolution *not* to attend to a given stimulus. *Spontaneous attention, then, working in the main upon the sensory material supplied by the physical surroundings, constitutes probably the earliest and most fundamental type of attention process.*

(1) *Voluntary attention* is apparently a derivative form of spontaneous attention, which may arise as soon as, and whenever, there is a tendency to the *splitting of attention,* a felt tendency to opposition against the direction our attentive energies are taking. Evidently this can only occur when we have developed intellectually to a sufficient degree to set over against some momentary disposition, or action, a more or less definitely formed plan involving interests and purposes opposed to the present activities. When we say that in voluntary attention we force ourselves to attend to some particular object or idea, what we evidently mean is, that the mind in its entirety is brought to bear in suppressing certain disturbing objects or ideas, and in bringing to the front the chosen ones. The act of voluntary attention is, in short, an expression of the sovereignty of the whole mind over its lesser parts, *i. e.,* over the disturbing or alluring ideas and sensations.

(2) As has been already pointed out, *spontaneous,* or *non-voluntary,* attention is likewise in reality just such an expression of our total mental organisation at the moment. Those things to which we spontaneously attend are the things to which our minds, by virtue of their temporary condition, inevitably go out. And if we took into account the entirety of these spontaneous acts of our attention for any considerable period of time, we should undoubtedly secure an extremely accurate portrait of the real constitution of our minds. In the sense, therefore, upon which we commented briefly in an earlier paragraph of the chapter, non-voluntary attention is itself an expression of the individuality of the mind, and thus an expression of the true source of our volitional acts. It is a sort of voluntary attention, in which there is no *internal,* mental opposition to be overcome, and from which we are consequently apt to feel one characteristic fact of complete volition has been subtracted. *External* obstacles are of course repeatedly encountered and mastered in this form of mental activity. It appears, then, that the distinction be-

tween voluntary and non-voluntary attention is not absolute, in the sense that we can always determine without question to which class a specific case of attention belongs. Quite the contrary. It appears that there is a gradual transition from one class to the other, through cases which partake of the characteristics of both forms.

Thus, for example, we should have to admit the existence of many cases in which it would be all but impossible to say whether we were attending to certain subjects as the result of a definite purpose and an explicit effort to attend, or as the result of more or less unconscious mental drifting. What shall one say, for instance, of the attention which is given to the routine duties of daily life? Some of them undoubtedly require definite, purposeful attention. Others enlist our spontaneous interest, require no effort and reveal little or no antecedent purpose to attend. Many others are surely on the border line, where it is not easy to say whether our attention is altogether due to spontaneous interest or to preconceived purpose. Meantime, we must admit that it is in voluntary attention that consciousness raises the human being into the greatest freedom from mere routine, with the greatest independence from mere temporary surroundings.

(3) The true relation of *involuntary* attention to voluntary and non-voluntary attention can hardly be understood without reference to the psychophysical organism as a whole. But fortunately we have all along taken this into account, and our present mention of it will mark no change in our point of view.

So far as concerns such instances as those in which we are forced against our will, or at all events without our mental consent, to notice intense sensations, it would seem that involuntary attention must be fundamentally opposed to voluntary attention at least, whatever might prove to be the case as regards non-voluntary attention. The one form of attention expresses the will, the other either defies, or disregards.

the will. Such differences certainly appear to be fundamental; but we shall see reason to modify this view, when we consider that both forms of attention are vital functions which are brought out and developed in the general adaptive reaction of the organism to its social and physical surroundings. If we remember that those objects which are harmful to us commonly stimulate the nerves very violently, we shall begin to see how in the general economy of the organism it may be useful to have our senses so constructed that they shall call our attention to such possible sources of danger as are represented by these intense stimuli, even when we do not consciously desire to have our quiet thus invaded. We shall begin to see that in the interests of the continuation of life and health it may be desirable that loud sounds and extreme temperatures, intense lights and violent odours, should have the power to elicit the attentive reactions from us, just as do the pains of over-fatigue and of diseased conditions of our bodily organs. In a sense, therefore, such reactions are instances of a kind of *organic* selection from among various movements of just those which shall result in our making momentary accommodation to the invading stimulus. If it prove really menacing, we may then take to flight, or adopt such other precautionary measures as the situation demands. If it be, in point of fact, innocuous or insignificant, our minds are left free to revert to the interrupted occupation. Involuntary attention of this kind represents, accordingly, the protest of the primarily physiological portion of the organism against a too complete subserviency to merely intellectual conscious processes.

Involuntary attention is only involuntary when the mind is viewed in isolation from the body. It is a kind of spontaneous bodily attention, and it is undoubtedly selective in a true enough sense. Moreover, even when viewed from the mental side alone, such attention could only properly be called involuntary, never passive. The term passive is quite misleading. Involuntary attention, once it is aroused, is just as genuinely a form of mental activity as is voluntary attention. Its antecedents, both mental and physical, are in part different and often its consequences are different too. But both operations are mental acts, and neither of them can properly be designated in terms of pure passivity.

Summarising Statement on the Forms of Attention.—In all forms of attention, then, we find selective activity revealed. Selection always implies a purposive, forward-looking type of action, and this is precisely what attention is in all its forms. It stands for the fact that the organism is teleological in its very constitution. That is to say, the organism contains within itself certain *ends* to be attained in course of development by adjustive activities. In part these ends exist imbedded in the physiological mechanisms, where they come to light as reflex, automatic, and instinctive acts, sometimes accompanied by consciousness; and in part they exist as conscious purposes, in which case they appear as recognised intentions. In spontaneous and voluntary attention the psychological antecedents of the act are more conspicuous, in involuntary attention the physiological antecedents are more prominent. All three forms, however, involve as a matter of course both neural and psychical factors. Figure 34 indicates the genetic relations of the three forms of attention.

FIG. 34. Showing genetic relations of forms of attention.

Duration of Attention.—It is extremely difficult to secure reliable information as to the length of time we can and do attend to objects in non-voluntary and involuntary attention, for the conditions in these forms of attention are necessarily very unfavourable to accurate introspection. But having discovered that the differences among the several forms of attention are relative and not absolute, we may, perhaps, safely assume that the facts which we find in voluntary attention are fairly representative of the other forms, and these facts are fortunately rather easy to make out. All voluntary attention displays a more or less rhythmic pulse, the duration of which varies considerably under different conditions. If we attempt to attend to a letter on this page, we shall find that we can only do this for a moment or two, unless we constantly observe something new about it. Otherwise we invariably find, either that the eye has moved away to something else, or that the mind has wandered off on to an entirely different subject. However constant the physical object may remain, to which we thus attend, we can only continue our attention to it provided we continually see it in some fresh fashion; provided, that is to say, that the *mental object* keeps changing. This seems to be a fundamental law of our mental life, and did space permit we might profitably enlarge at some length upon its implication. A few consequences we may properly pause to mention.

A. Consequences of Change in the Focus of Attention.—Evidently change is the primal law of mental life, as well as of bodily life. Thought processes which cease to move, cease to exist. They simply go out. To keep a thought alive we must keep turning it over, keep *doing* something with it. Mental paralysis is mental death. It is a familiar experience with all of us, especially with students, that occasionally when a question is asked us our minds either become perfectly blank, or remain for a moment stupidly confronting the mere sound of the words addressed to us. In such a case the only salvation lies in doing something, *doing* almost *anything* is better than such quiescence. Often to begin speaking is sufficient to break the spell, however pointless our remarks may be. The act of speech starts up the cerebral machinery and presently, if we keep our composure, we get our thought once more in movement. Similarly, the boy told to *think* about what he is studying finds himself, in the effort to execute the injunction laid upon him, simply surveying the page before him with an apathetic gaze. He is merely exposing himself innocuously to the light waves proceeding from the page. Mentally he is either in a condition of partial asphyxiation, or his mind is off engaged upon something really of interest to him. He is not in any proper sense *attending* to the subject matter of his work at all. For such a youth the sole possibility of progress consists in taking the topic and forcing himself to turn it over, ask questions of it, examine it from new sides. Presently, even though such questions and inspections be very foolishly conceived, the subject will start into life, will begin to connect itself with things he already knows, will take its place in the general furniture of his mind; and, if he takes the next and all but indispensable step, and actually puts his rudimentary information to some use, applies it to some practical problem, incorporates it, perhaps, in an essay, or even talks about it with others, he will find he has acquired a real mental tool which he can use, and not simply a dead load which must be carried on his already aching back.

What we call *attending* to a *topic* for a considerable period of time will, therefore, always be found to consist in attending to *changing phases* of the subject, to ideas associated with it. Thus, to fix one's mind upon history for an hour or two will involve attending to hundreds of thoughts about the special historical subject, or problem, with which we are concerned. Accordingly, these instances of the practical continuation of attention to a single subject strongly confirm our position, instead of contradicting it, as might seem at first sight to be the case.

B. Why Attention Shifts.—It has been suggested that the rapid changes of attention are due primarily to fatigue in the delicate cortical cells which are connected with conscious processes. Whether this statement be accepted or not, we gain a very significant suggestion in explanation of these changes, when we remember what the essential function of attention appears to be. We remarked at the outset that attention is simply a name for the operation of the central, and most active, portion of the field of consciousness. We have all along maintained that the real business of consciousness is to be sought amid the adaptive responses of the organism to its life conditions. We have also pointed out that, if this conception be true at all, it is at the point of attention that we shall find the most obvious and important part of the adjusting activity in progress. Now, in the nature of the case, each particular act of adjustment must be of relatively brief duration. In the case of common objects in the world of sensations it consists as a rule merely in the recognition of the stimulus (*e. g.*, as a colour, as a sound, as a book, or a word, etc.), with a motor response, which consists, perhaps, in some movement of the eyes or head calculated either to bring to notice some new and useful phase of the stimulus, or to divert further attention altogether away from it. Thus we look, for instance, at a book, recognize it as the one for which we are searching, pick it up and proceed to examine it; in this way continuing the activity of attending to the book, but, as a matter of fact, continuing it in the form of attention to ever new features. The same sort of thing is true when our attention is occupied with ideas, instead of with sensations. In short, so far as attention is really an activity of the relating, adjusting kind, its work is done when the relation between the mind and the thing attended to is once established. This *is* the *mental,* as distinct from the physiological, part of the adjustment; and attention must go elsewhere, because it is intrinsically the adjusting act itself, and *other things are demanding of the organism the same energies of adjustment.* To retain our attention for any considerable period an object must, therefore, by changing its aspect, present itself as a new object, to which fresh responses can be made. No doubt we find here the reason why painful objects are so imperious in their monopoly of our attention. They demand an adjustment which we are often unable to make successfully and attention consequently recurs to them again and again.

Range, or Scope, of Attention.—The question is often asked: How many things can we attend to at once? Various answers have been given, some authorities maintaining that we can attend only to one object at a time, others insisting that we may attend to an indefinite number. We must sharply distinguish between the question in the form in which we have given it, and the question often, but erroneously, treated as synonymous with it, *i. e.,* How many things can we *do* at one time? We have seen in the preceding chapter that there is literally no limit to the number of things we can learn to do at once. It is, in this latter case, simply a question of how elaborate we can make our habitual motor activities. A skilled pianist, or a trained acrobat, may do dozens of things simultaneously. But the question of how many things we can attend to is much more puzzling.

The differences of opinion upon the matter are, however, apparently due in the main to a failure to define with precision the underlying mental conditions. It is the view here adopted, that we never have more than one *mental object* before the mind at any one moment. This object may be complex, or simple, but if it is really present in its entirety to consciousness, it is cognised mentally as a single thing. To illustrate, we may take the case of perceiving a table. If we examine introspectively the manner in which we are conscious of such an object, when we allow the eyes to rest momentarily upon it, we find that we perceive it as a complex *single* object; not as four legs, plus a top, plus a colour, plus a particular shape, etc. Now, these characteristics of a table which we have mentioned all correspond to distinguishable parts of it, and we might speak in a certain sense of having attended to all these circumstances at once. But this would be an injudicious mode of expression, tending to confuse our ability to analyse the physical object, or our own consciousness of the object, with the fact of the manner in which we *actually perceived* it *in* our momentary glance. However many things, therefore, may be present to us at one moment, it seems probable that our consciousness is of all of them as a single mental object, which we may, nevertheless, immediately recognise as being complex in its constitution, meaning, and references. Indeed, we may go further, and say that in order to perceive an object as one, there *must* be some complexity in it, which we thus synthesise into a unit. A pure, undifferentiated conscious quality never does, and apparently never can, constitute the object of a cognising consciousness. Plurality is, in short, just as necessary for an object of attention as unity; but our mental activity always gives the stamp of unification to these plural particulars. How many such particulars can be brought together in any one act of consciousness is a practical problem for experimental psychology.

The various interesting experiments which have been performed to test the so-called *scope* of momentary consciousness must all be interpreted in the light of the foregoing considerations. Thus, we find that with momentary exposure we can cognise visually four or five letters, under proper conditions. When the letters make words the number which we can cognise in this instantaneous fashion quickly rises. It is possible to make the exposure time so short that we cannot perceive anything with certainty. As the duration of the exposure is lengthened, we soon reach a point where we can feel our attention rapidly shifting to take in serially two or more groups of the letters or words. Similar experiments have been made with sensations other than those of vision with results differing in detail but similar in the principles involved. To these facts we shall revert in another chapter.

Some sensations, which have become thoroughly dissociated from one another, seemingly refuse to come together at all into simultaneous objects. Thus, experiments have been made which render it altogether problematic whether we can attend to a sound and a colour simultaneously. We hear the sound and then the attention oscillates to the colour, or vice versa. The same thing is true of sensations of contact, when conjoined with either sound or colour. On the other hand, fusions of two kinds of sensations, like those of taste and smell, are of course always attended to as simultaneous. They are not sensed as two.

Inattention and Scattered, or Dispersed, Attention.—*Inattention* is often spoken of as though it were a positive mental condition, just like attention. As a matter of fact inattention to any subject simply means attention to some other subject. In school-children of various ages this condition is often exasperating to the last degree. Its cause, however, is not the absolute loss of attention, but the direction of it into some forbidden but attractive channel. Wandering, or sporadic, attention also is never, properly speaking, the negative of attention. It is simply the unstable, flitting, inefficient form of it. This condition is sometimes spoken of as scattered attention, and, when not due to actual mental disease, is certainly attributable, if long continued, to bad mental surroundings, *i. e.,* surroundings which neither encourage nor give scope for the expression of native and normal interests. It is proper enough to speak of the marginal part of the field of consciousness and of the unemphasized aspects of the focal part as belonging to the region of inattention, but such expressions must be understood as marking differences of degree in attentiveness, not a radical distinction in the kind of process concerned.

Dispersed attention is another much abused term. To have one's attention completely dispersed would be to become unconscious. The conditions properly describable by this term are illustrated in the general lowering of our mental alertness when we become drowsy. Mental distinctions of all kinds tend, under such circumstances, to become blurred and indefinite. The state is one of fading attention. Nevertheless, as long as we are conscious at all, we are always more clearly aware of some part of the field of thought than we are of the remainder. Our attention is never distributed evenly over the whole of the conscious field. If it ever were thus distributed, completely dispersed attention would, indeed, be realised.

Motor Accompaniments of Attention.—It will be remembered that in our account of the nervous system we mentioned the existence of evidence tending to show the importance of the association areas of the frontal lobes for the higher forms of mental process involving concentration of attention. In our description of attention thus far, we have also made occasional reference to the part played by sense organs and brain; but this has been somewhat incidental, and we have hardly noticed at all the conspicuous position of muscular activities. To bring out the significant facts bearing on these matters it will be convenient to avail ourselves temporarily of another common classification of attentive processes, differing from that which we have employed. This is the division of attention as sensory, or ideational; a division which certain of our illustrations have involved. All attention to objects stimulating the sense organs, every process, therefore, of sensation and perception, involves sensory attention. All attention to ideas, images, thoughts, etc., is ideational attention. The first type of activity involves both sense organ and brain, whereas the second type involves immediately only the brain.

A. In Sensory Attention.—In normal sensory attention muscular movements seem always to be concerned. These movements are accommodatory, and are calculated to put the sense organs in the best attitude to receive distinct impressions from the objects stimulating them. In vision, for example, if we see to best advantage, the eyes must converge upon the objects at which we are looking, the lenses must be accommodated to the distance of the object, and oftentimes the head must be turned, in order to permit the most effective visual operation. In hearing, we similarly tend to turn the head toward the source of the sound, or at all events, to turn in that direction the more sensitive of our ears. In taste, we press against the substance in the mouth with the tongue in order to detect most fully its flavour. In smelling, we inhale in order to bring the odorous particles against the olfactory membrane at the upper part of the nasal cavity. In touch, we explore the object with the hand, if we desire accurate information of its tactual characteristics. We find a similar state of things true, as regards all our sensations, when we make them the object of direct attention.

Each of these cases illustrates the function of the sensory-motor circuit. The light rays falling upon the retina set up currents in sensory nerves, which are transmitted to cells in control of the muscles of the eyes; and these cells in turn send out impulses, which result in convergence and accommodation. In some cases the sensory impulse may originate in a cortical centre, or in a sense-organ other than that which experiences the modifications of the accommodatory movement. Thus, the hand may be moved in response to an idea, or in response to a stimulus from the eye, and not from the skin of the hand itself.

B. In Ideational Attention.—Psychologists have observed a similar kind of muscular accommodation when our attention is directed to intellectual processes. Thus, if we close our eyes and attempt to get a visual mental picture of some particular place, it will generally be found that the eyes tend to turn in the supposed direction of the imagined locality. In attempting to recall an odour we almost inevitably make slight movements of inhalation. In calling up images of taste the tongue moves and salivation is stimulated.

Furthermore, the effort to fix our attention firmly upon any train of thought is generally accompanied by a strong tendency to assume some specific bodily attitude, in which we somewhat unconsciously seek to prevent the distraction of our attention by outside disturbances. In this effort the brows are often wrinkled, the breathing impeded, the body bent over and held rigid, the hands clenched, the head tilted in this way or that. The attitudes which we thus assume evidently share with the sense-organ accommodations already mentioned, the function of putting the organism in the most advantageous position for meeting the special demand momentarily laid upon it. Indeed, many of these attitudes are characteristic of all attentive process whether sensory or ideational. The psychophysical effort at concentration overflows in movements calculated to assist in reaching the desired end. The actual value of these movements probably varies greatly, and depends (1) upon their success in eliminating, or neutralising, the effect of the disturbing stimuli from without; and (2) in their contribution, through their cortical effects, toward the continuation of the ongoing activity. Thus, if more nervous energy is being liberated than can be properly disposed of by the pathways of discharge involved in the special matter in hand, these overflow motor pathways may be called in to take care of the excess of neural activity, and so indirectly further the ongoing occupation.

C. Involuntary Muscular Processes and Attention.—Experiments show that the involuntary muscular processes, such as those of respiration and circulation, also reflect the changes in attention. When attention is much perturbed, they display rapid and relatively violent oscillations. When, on the other hand, attention moves along smoothly, these motor reactions are also stable. Extensive investigations have also been made to establish the correlation of certain fixed forms of circulatory and respiratory activities with voluntary and involuntary attention respectively. The results are too complex and too imperfectly confirmed to justify description here.

Sensory Indices of Motor Attitudes in Attention.—The motor activities which accompany processes of attention necessarily, at least in the case of the voluntary muscles, send back toward the cortex sensory impulses, which may then enter into the general field of consciousness to modify its complexion and tone. These are sometimes spoken of as the "strain sensations" of attention. It seems probable that there is a small group which characterises in some measure all attention, and that the use of any special sense, or any special form of ideational process, involves another specific and relatively constant group. The intensity of these sensations necessarily varies widely from time to time, and is commonly greatest in cases of intense voluntary attention. The muscles most regularly and most obviously affected are those of the face, throat, and chest, although the hand and other parts of the body may be involved. The breathing movements are almost sure to be involved in cases of vigorous attention.

Dr. Gordon has suggested another interesting explanation of the function of these strain sensations. It is possible that in attempting, for example, to force our attention along some mentally difficult path, we primarily crave *more* nervous excitement and stimulation, more push *a tergo;* and these muscular activities setting up definite sensory impulses, which return to the cortex, may possibly furnish this needed help. It may well be that all these accounts of the motor aspects of attention are correct. After what has been said it is, perhaps, unnecessary to insist that motor processes are bound up in an inextricable way with the movements of attention, both as leading up to its effective activity and as secondary consequences of its operation. The idea of the sensory-motor circuit proves to be radically implicated, therefore, in every form of conscious action.

Genetic Features of Attention.—All the evidence which we can command, coming in part from the examination of our own mental operations as adults, and in part from observing how children deal with the objects about them, points to the notion that the active portion of the field of consciousness is from the very first given over to the double process of pulling apart and putting together the various elements of experience. These two processes are commonly known as dissociation and association. It seems to be fairly certain that at the outset of life consciousness is extremely vague and crude in its organisation. To begin with, there is, perhaps, no definite distinction felt between the various kinds of sensations, visual, auditory, tactual, etc. Certainly the process of distinguishing the various kinds of sensory qualities within the range of any given sense series—like the spectral colours in the field of vision—is quite slow in developing. The various colours are undoubtedly distinguished from one another very imperfectly even up to a late period in childhood. The discrimination of differences in form definitely antedates this ability to recognise colour distinctions and in cases of arrested development the latter may never be acquired satisfactorily even though the former is relatively normal. Nevertheless, after the first moment of consciousness the mind is constantly at work, splitting up experiences which previously were felt as simple, and bringing about an increasingly definite awareness of the several distinguishable qualities within them. The analytical activity disclosed in attention is what we called above dissociation, or discrimination. Although we shall have a great deal to say about it under other titles further on in the book, we must glance at some of its more conspicuous features here.

II—DISCRIMINATION AND ASSOCIATION

Analytic Aspect of Attention: Discrimination.—When the different distinguishable elements of any state of consciousness blend with one another, so that they lose their individuality, we speak of the resulting condition as a case of *fusion*. Thus, the partial tones in a piano note are generally lost to us as separate sounds, and we seem to hear only a single musical tone. Similarly, when we grasp a book we seldom distinguish the sensations of pressure from those of temperature and tendinous strain. These sensations fuse. Again, the sensations which we get when eating onions, or when drinking coffee, we commonly speak of as being tastes. In point of fact, they largely depend for their characteristic quality upon smell sensations, which fuse with the tastes and in consequence are entirely overlooked by us. This can readily be proved by stopping the nostrils when the substances are taken into the mouth. The effect of a severe cold in the head in depriving us of our sense of taste is really largely attributable to its influence on the membranes of the nose. Now, it seems probable that the original tendencies of all sensory stimuli, which impinge upon our sense organs simultaneously, is to fuse in just this same fashion; so that were it not for this discriminative activity which we are describing, we might remain oblivious to much of the complexity of the objective world.

Undoubtedly the compelling motive to such discrimination is in the first instance the necessity for practical control over objects. If we could deal with objects successfully while disregarding differences of colour and form and size, discrimination would fail to develop. But this of course is not the case. The situation is similar to that noticed in the last chapter where we found gross general movements splitting up into finer and more precise ones. Meantime, it must not be overlooked that once we have succeeded in analysing some of these originally fusing qualities, we may find their distinctness and separateness enhanced by being experienced simultaneously. Colours, like black and white, red and green, may gain in definiteness and individuality by the contrast effects of juxtaposition.

Primary Conditions of Discrimination.—However it may be in later life, there can be no question that during the first year or two the great agent in furthering discrimination is the change in the objective stimuli, which affect the sense organs from moment to moment. Thus, sounds sometimes occur simultaneously with stimulations of colour, and sometimes they do not. Stimulations of red sometimes occur together with stimulations of blue, and sometimes with white. These changes in the mode of sensory stimulation necessarily produce different forms of cortical reaction; and, as consciousness is conditioned by these cortical activities, we have thus a basis for different states of consciousness. That we are able to recognize the fact that one state of consciousness differs from a second, and is like a third, is an ultimate fact which we cannot further explain. All psychologists agree that this is a fundamental attribute of consciousness, and, so far as concerns the conditions under which we actually come in the first instance to attain this awareness of differences, the description we have just given seems to represent the undoubted facts. We can put the matter diagrammatically, as in figure 35. So long as a certain taste sensation *T*, and a certain smell sensation *S*, are always given us together, we fail to note the complexity of the sensation, and we experience (1) a fusion possessing

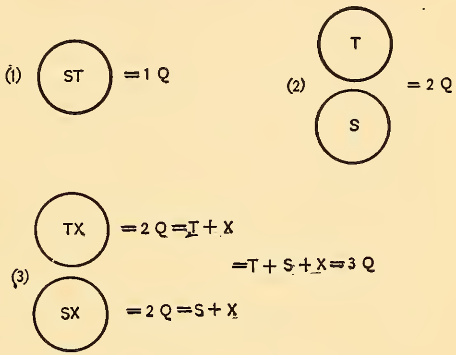

FIG. 35.

a single quality, 1 Q. When, however, (2) the sensation T, or the sensation S, is given *alone* or (3) in combination with some *other* quality, we may, when the complex TS is again experienced, discern the two qualities—$2Q$, *i. e.*, T and S. In experiencing either TX or SX we shall also be in a position to discriminate X. In each case we have, by varying the concomitants, produced a new psychophysical condition, in part different from and in part like its predecessors, and in this way we have provided the prerequisites for the analysis of compounds.

Evidently, if these are the preconditions of our original capacity for the dissociating process, any device which facilitates the arousal of different nervous conditions will assist us in making our discriminations. Submitting objects to successive, instead of simultaneous, inspection produces a maximum of nervous difference; and we find accordingly that if we wish, for example, to detect the heavier of two objects of nearly equal weight, we judge most accurately when we lift them immediately in succession. If we wish to tell whether or no two colours match, we let the eye pass rapidly from one to the other, etc. Of course, when the objects stimulate different sense organs there is already considerable difference in the nervous processes resulting, and to discriminate among them it is only necessary to let either sense be stimulated independently. The use of words has been shown experimentally to assist in discrimination in cases involving memory, *e. g.*, when we attempt to remember and identify colours, if we can assign them definite names, our task is much facilitated. The kind of discrimination, or comparison, which occurs among ideas in the higher processes of reflection, reasoning, etc., we shall consider at a later point. The form of dissociation which we have described clearly underlies the higher form, because it is concerned with our primary analysis into its rudimentary features of the world as we first know it.

Synthetic Features of Attention: Simultaneous Association.—Hand in hand with these dissociative, analytical activities is to be found a synthetic process, which serves to unite the various dissevered elements, and to which the name association is commonly given. In a logical sense, one phase of this associative process really precedes and underlies the dissociative activity; for it is evident that if we are to differentiate the two qualities *A* and *B* from one another, they must already be associated in some kind of fusion such as we have just been describing. Thus, to distinguish the colour white from the colour black upon this printed page involves not only that the black and the white objects shall be side by side in the space before me, but also that they shall in a way be together in my mind.

It is clear that every act of attention must involve in some degree both discrimination and this form of "simultaneous association." We may, for example, remark that the colours upon a postage stamp are red and white. Such an act is evidently one of discrimination. But it is also quite as truly one of association, for the qualities must be experienced together, must be mentally synthesised, that this special kind of discrimination may occur at all.

It has already been stated that when sensations are experienced in forms where they blend in such a way as to lose something of their individuality, *e. g.*, the partial tones of a violin note, psychologists sometimes speak of the simultaneous association involved as a *fusion.* When the conscious complex emphasises the individuality of its components or leaves this unimpaired, as often occurs in the perception of colours, it is by certain authors called a *colligation.** Mental images and ideas show the same sort of differentiation in this particular as do sensations.

*The term complication is *sometimes* applied to combinations involving elements from different senses. We shall mention these cases in our study of perception.

Successive Association.—There is another form of association, known as successive association, a term which is commonly restricted to the *sequence* of our *ideas* as they pass through the mind. We shall discuss it in connection with imagery and the higher cognitive functions. Even this kind of association of ideas, however, evidently involves discrimination; for the ideas must be noticed as different, in order that they may be separate ideas at all. And conversely, so far as we remark differences in successive moments of consciousness, we must admit the presence of associative factors of some kind or other, uniting the several temporally distinct contents of consciousness with one another.

Generalising, then, we may say that attention involves both a synthetic and an analytic activity. Sometimes our primary purpose and interest in attending is to analyse and discriminate, but we cannot accomplish this without simultaneously employing association. And similarly, although we may be ostensibly engaged in connecting, or associating, the various items of our experience with one another, the execution of our task inevitably involves us in discrimination.

CHAPTER V

SENSATION

Elementary Sensory Processes.—The first step in the activity of the sensory-motor circuit, which represents, as we have seen, the unit of action in the nervous system, is the sensory stimulation. This stimulation is reported in consciousness as a sensation, at which point we shall accordingly begin our detailed study of the various portions of our psychological processes.*

Our task as psychologists requires that we study each of the great groups of sensation in order to detect its intrinsic psychical peculiarities. This will bring to our notice, beginning with the more rudimentary senses, cutaneous, organic, kinaesthetic, gustatory, olfactory, auditory and visual sensations. We must analyse these as far as we can into their elementary qualities and attempt to discover the relations of these qualities to one another. We shall notice in each case the more important of the known physical and physiological facts upon which the sensations depend. Toward the end of the chapter we shall describe the function of sensation and consider a distinction which psychologists make between sensation and perception, both of which are sensory processes.

Our undertaking will necessarily involve our examining

*Some psychologists regard the feelings of pleasure and pain as even more primordial than sensation in this primitive sensory-motor activity of the organism. Be this as it may, we shall find it practically more convenient to examine the *cognitive* functions of the organism first; that is to say, those which *inform* us most definitely of objects, including our own bodies.

various aspects of consciousness one at a time, and we must unavoidably turn our backs temporarily on most of the processes, apart from the special one we are for the moment engaged in studying. We must bear contantly in mind, therefore, this partial and tentative mode of procedure, remembering that the mind, which we thus analyse piecemeal, is in point of fact a real unit.

It will assist us to gain a proper appreciation of the significance of sensation to remark at the outset certain facts about the evolution of sense organs.

The Evolution of Sense Organs.—That it may be put into the most delicate and complete accord with the world in which it is placed, the organism must be capable of responding to the various objects found therein. To this end we find the sense organs so devised that they may give information about the most widely differing kinds of physical existence. Each form of sensation which we possess is apparently connected with the activity of a specially constituted receiving apparatus. In some cases this apparatus is extremely complex, as in the eye for example; in other instances it is very simple, as in the case of the so-called pain nerves of which we shall speak in a moment. These end-organs are connected with special parts of the cerebral cortex which they incite to activity. These cortical connections we examined in Chapter II.

There seems to be no doubt that even very simple forms of organism are sensitive in a rude way to most, if not all, of the types of sensory stimuli to which human beings respond, *e. g.*, light, sound, mechanical impact, etc. This is simply another way of saying that protoplasm itself is sensitive to these modes of stimulation. But so far as concerns the development of definitely differentiated sense organs, specially devised to receive particular modes of sensory stimuli, the facts seem to indicate great irregularity and wide variation among different organic forms. The kinds of sensitivity which are most certainly and regularly present in the lower orders correspond most nearly to the human cutaneous sensations of touch, pain, and temperature. But beyond such a statement as this, we are hardly in a position to offer any definite outline of sensory development. Not a few animal forms well up in the scale of organisms seem to possess sense organs unknown to man, the nature of whose functions we can, therefore, only speculate about. Moreover, when we come to animals on the level of the birds and quadrupeds, we come upon astonishing anomalies. For example, it seems possible that some birds are essentially destitute of the sense of smell. At all events they make little or no use of it. This is said to be true of vultures. On the other hand, certain dogs seem to live in a world in which smell probably plays a predominant part. Speaking generally, advance to any high level of intelligence is accompanied by an increasing prominence of vision and hearing, and a decreasing prominence for the rest of the sensations. This fact seems to be largely due to the superior richness and flexibility of the material supplied by these two senses for elaboration into ideational processes. Moreover, these senses are the ones which afford most detailed and accurate information of objects at a distance—an important consideration in developing organisms. Smell is their only rival in this particular, and for purposes of general orientation, as regards prey, or dangerous animal foes, is made large use of by many wild creatures.

We are now ready to pass to a detailed consideration of the several sensations.

Analysis of Cutaneous Sensations.—From the skin we obtain as the rudimentary qualities of sensation, cold, warmth, pain, and pressure. Certain psychologists maintain that heat—commonly thought of as merely intense warmth—is qualitatively distinct from warmth and depends upon the simultaneous stimulation of both warmth and cold. It is from this viewpoint in reality a fusion, whether it be so sensed or not.

The evidence for our statement, as to the elementary qualities of the cutaneous sensations, consists in the careful examination of every kind of psychical experience which we can obtain from the stimulation of the skin. These stimulations can be produced by mechanical impact—either pushing or pulling—by certain chemicals, such as the acids, by electricity, and by temperatures distinctly above or below that of the skin itself.

At first, it may seem that we have many other elementary qualities peculiar to cutaneous reactions. Thus, it is common in the older text-books to see such asserted sensations as hardness, softness, wetness, dryness, active and passive touch, sharpness, smoothness, roughness, etc., referred to the skin. It is true, of course, that these several impressions originate in the skin. But they are quite certainly either compounds of pressure with some of the other sensations already mentioned, or else mere modifications of pressure itself. Thus, if one heat a drop of water to the exact temperature of the skin, and then place it on the hand, it will prove very difficult to imagine any sensation caused by it other than pressure. Similarly, if a hard and a soft object be made thermally indifferent, and both be laid very gently against the skin, pressure will be the only sensation confidently felt. As the intensity of the pressure increases, the difference will be remarked. But hardness simply means more intense pressure, plus, on most occasions, certain sensations of effort, resistance, or strain, which come from muscles, or tendons, and not from the skin. And so with the other experiences suggested above. When carefully examined, they will all be found capable of resolution into pressure, or pressure and some other sensation, like that of temperature, or tendinous strain.

Itching, tickling, and creepy sensations of the skin probably originate at times from the effects of circulatory changes upon the dermal end-organs. Occasionally, however, they are due to very light pressure stimulations. The creepy feeling is often a complex of the prickly pain sensations with cold sensations. There seems no reason to postulate any new elementary forms of sense experience because of these reactions.

If one takes a cool blunt-pointed object, like a knitting needle, and explores gently some portion of the skin, such as the back of the hand, it will be found that at certain points there flashes out a distinct sensation of cold. At other spots nothing but pressure will be felt and if the impact be very gentle, not a few places will be found from which no sensation at all is gotten. If the point be slightly warmed, a similar series of occasional warmth sensations will be elicited. If a fine broom straw or horse hair be substituted for the knitting needle and the explorations be continued with a gentle pressure, many spots will yield a distinct cutting pain sensation. From other spots a somewhat dull sensation of pressure will be noted and from still others, the so-called 'pressure spots,' will issue a sensation described by many persons as feeling like a grain of sand caught beneath the skin. This sensation is reported by certain observers to be less simple in composition than the others. It is somewhat like a combination of mild pain with pressure. The dull sensations are held to be simply dim, faint sensations from neighbouring 'pressure spots.' Under moderate stimulation, then, the skin appears as a delicate mosaic of sensitive and insensitive points.

The temperature sensations can be produced by electrical stimulation, and by tapping upon the skin with an object which is thermally indifferent. Moreover, sensations of cold are sometimes gotten from stimulation with objects slightly warm. These are the 'paradox' sensations of von Frey. Such facts would evidently seem to indicate the existence of some special organs for these particular sensations. These organs when stimulated would always respond with a specific sensation, regardless of the nature of the stimulus. The fundamental peculiarity of the temperature sense is its ability to effect accommodations to changes in the objective temperature. The air feels cold when we first go out-doors on a winter day, but presently we cease to notice it. We accommodate to it. No wholly satisfactory explanation of this capacity of the temperature nerves has been found. Figure 36 shows a rude map of the temperature spots, which are less numerous than the pressure spots and much less numerous than those responding with pain.

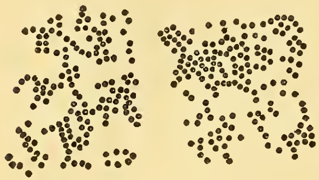

FIG. 36. *C*, cold spots; *H*, hot spots. (McKendrick and Snodgrass after Goldscheider.)

Naturally, it often happens that the various sorts of sensitive spots (pain, pressure and thermal) are very close together, so that it is frequently possible to secure several kinds of sensations from what is apparently one and the same spot. Furthermore, it is broadly speaking true that if the stimulus be made very intense, any portion of the cutaneous surface will respond with the appropriate sensation. But the widest variations of sensitivity are encountered. Upon the cornea even the gentlest contact is likely to be painful; whereas there is an area upon the inner surface of the cheek which is said to be quite insensitive to the prick of a needle.

Neural Basis of the Cutaneous Sensations.—The facts about the cutaneous end-organs have been strangely difficult to determine and the statements made in this section are in large part frankly conjectural. They represent, however, the best opinion at this time. It may be that the structures pictured as receptive organs are in reality merely protective or something of that kind. They are found in the skin and mucous membranes. (See figure 37.)

The sensations of touch or contact probably come from the stimulation of minute structures in the dermis—the true skin—(figure 37C, E), and from nerves ending about the

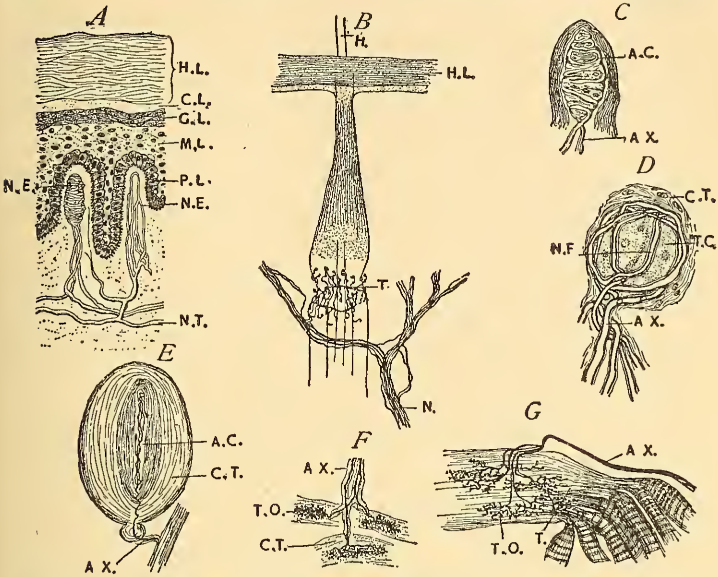

Fig. 37. *A*, a diagrammatic cross section of the skin showing *H. L.*, the horny layer of the epidermis, *C. L.*, the clear layer, *G. L.*, the granular layer, *M. L.*, the mucous layer, *P. L.*, the papillary layer, forming the outer border of the dermis; *N. E.*, nerve endings, and *N. T.*, the trunks of the nerves. *B*, diagrammatic cross section of the skin showing a hair and the nerve winding about its base; *H.*, the hair; *H. L.*, horny layer of the epidermis; *N.*, nerve trunk with terminals, *T.*, about the base of the hair. *C*, a tactile corpuscle of Meissner. *AX.*, the axonic processes wrapping about the tissue of the corpuscle. *A. C.*, naked axis cylinders. *D*, end-bulb of Krause. *AX.*, axones entering the bulb; *N. F.*, naked axone fibres; *T. C.*, so-called touch cells; *C. T.*, connective tissue of the skin. *E*, Pacinian corpuscle; *AX.*, axone entering the corpuscle with axis cylinder terminations at *A. C.*; *C. T.*, connective tissue. *F*, Ruffini's nerve endings; *AX.*, axones; *T. O.*, terminal organs; *C. T.*, connective tissue. *G*, termination of sensory nerve in tendon; *AX.*, axone; *T.*, tendon; *T. O.*, terminal organs. (Modified from Cunningham, Retzius, Morris and Toldt.)

roots of the hair (figure 37B). Sensations of cold probably originate from organs in the skin, such as are shown in figure 37D. It is possible that sensations of warmth come from the stimulation of special structures, such as are shown in figure 37F; and in the epidermis (the tough outer layer of the skin), as well as elsewhere, are found the so-called free nerve endings, *i. e.,* nerve fibres which become much attenuated and terminate without contact with any special end-organ (figure 15A). The stimulation of these fibres in the epidermis is believed to produce the cutting, smarting, burning sensations of physical pain, which must not be confused with the experience of mere disagreeableness.*

It is not necessary to repeat in detail what was said in chapter II about the central conduction pathways for these forms of sensory excitation, nor to describe again their cortical centres in the region posterior to Rolando.

Genetic Features of Cutaneous Sensations.—The touch, pain, and temperature apparatus in the nervous system is fairly complete at birth. The dependence—at least partial—of the delicacy of the action of the cutaneous senses upon the richness of the supply of nerve endings is suggested by the fact that children have a finer and more accurate sense of touch than adults. In the child there are practically as many

* Drs. Head, Rivers and Sherren of London have recently published the results of some interesting experiments on the manner in which sensitivity is restored to the skin and underlying regions, after section of the sensory nerves. Their results do not bring evidence of any new sense qualities, but may well necessitate a revision of our ideas about the psychological and anatomical relations represented in the cutaneous senses. They find that the afferent fibres may be divided into three groups. (1) Those which "subserve deep sensibility and conduct the impulse by pressure." The fibres of this system run chiefly in conjunction with motor fibres and are not *affected* by section of the sensory nerves to the skin. They enable accurate localization of vigorous pressure stimuli. (2) A system of fibres ("protopathic") which respond to painful cutaneous stimuli and to extremes of temperature. They may be stimulated also by moving the hairs. They recover their functions relatively rapidly after section of the sensory nerves. (3) A system of fibres ("epicritic") which respond to very light touch stimuli and convey the power to discriminate stimuli accurately with reference to their size, shape, intensity, etc., as the other fibre systems do not. These fibres regenerate slowly after section.

nerve endings for any given area of the skin as in the adult. But in the adult these nerves have to supply a much larger area, owing to the spreading of the skin through growth. The difference is most marked on surfaces not regularly used for touching, *e. g.*, the back of the arm.

Kinaesthetic Sensation Qualities.—Closely connected with the skin sensations are the kinæsthetic sensations, sometimes classified as organic sensations. When one lifts a heavy weight there is quickly noticeable, over and above the pressure sensation in the hand, a feeling of strain in the arm. When the hand is firmly clasped, this strain is also detectable. This sensation without doubt is largely referable to the tendons. There is also undoubtedly a muscle sensation. But without experimental appliances it is hardly possible introspectively to isolate the sensation from the cutaneous and tendinous sensations which accompany it, except in the case of moderate muscular fatigue. The sensation which arises under such conditions of fatigue is the specific sensation concerned. The joints, too, are contributors to this group of sensations, if not directly on their own account, then indirectly through their effect upon the tendons. Certainly we are extremely sensitive to their movements. But there is some difference of expert opinion as to the anatomical and physiological facts involved. The sensation which is experienced when we attempt to isolate the joint activity is strikingly like ordinary pressure. This isolation can be accomplished with sufficient accuracy by attaching a heavy weight to a cord, and then, while holding the cord, allowing the weight to sink rapidly to the ground. At the moment when it strikes, one feels a sort of "snap-back" sensation in the joints. Movement of particular parts of the body obviously constitutes the normal stimulus to these sensations. We notice them almost as distinctly when the parts are moved for us, as when we move them ourselves.

Neural Basis of the Kinaesthetic Senses.—It is known that sensory nerves are connected with muscle tissues and with the tendons. They are very numerous about the joints. The methods of termination are sufficiently similar to those already described in connection with the skin to render a detailed description superfluous. See figure 37G for sketch of a nerve ending in a tendon. The cortical centres which receive impulses from these nerves are no doubt chiefly in the Rolandic region, presumably posterior to the fissure.

Organic Sensations.—The respiratory and circulatory processes produce certain sensory experiences closely akin to the cutaneous ones, *e. g.,* the sensation of "closeness" in the air, perhaps, comes from a genuine intra-thoracic sensation. The sexual organs have a specific sensory quality, and the alimentary tract gives rise to the experiences of nausea, thirst, and hunger. It may, perhaps, be questioned whether these last experiences are not resolvable into other simpler constituent sensation qualities, in which pressure and pain, for example, possibly play a part, and with which the affective factors of pleasantness and unpleasantness are markedly connected. But the disposition among psychologists seems on the whole to be in favour of regarding them as real sensations, with probably some specific end-organ, although the case is far from clear.

Pain itself is often ranked as an organic sensation. The pains from the viscera and other deep lying organs must certainly be recognised in addition to the cutaneous pains already mentioned, however they be classified. The massive agony of certain of these pains contrasts strikingly with the ordinary experiences of dermal pain. Moreover, we occasionally experience pressure and temperature sensations from the internal surfaces of the body and such sensations should then be designated organic.

Properly speaking, the term 'organic sensation' applies to such sensations as report changes in bodily organs by which changes they are caused. The kinæsthetic sensations should strictly be grouped here. But they have functions so important for general conscious process as to render it judicious to mention them separately. We have used the term 'organic sensation' to designate those sensations which indicate most distinctly the progress of the vital internal affairs of the organism. We shall notice one group of sensations which forms a transition from the kinæsthetic to the organic class, *i. e.,* the static sensations.

When the whole body is moved, as occurs in a train or an elevator, we receive a distinct group of sensations which, quite apart from vision, report the fact of translation. If the body is whirled, we obtain the sensations of dizziness and disturbed equilibrium. Dizziness may of course be produced in many other ways, *e. g.,* by being on high places, by seeing objects in very rapid movement about us, and so on.

Neural Factors in Organic Sensation.—Our present knowledge of the end-organ arrangements of the sensations from the vital organs is rather too fragmentary and the subject as a whole rather too complex to warrant discussion and detailed exposition here. Speaking broadly, impulses from the sensory nerves of this group probably reach the cerebral cortex in the region immediately posterior to the fissure of Rolando. The static sensations have been referred to the semicircular canals of the internal ear, which it will be more convenient to study in connection with sensations of hearing. It is questioned by competent authority whether they contribute to our sense of translocation of the body, except when the movement is of a whirling character. It is at least certain that many other organs contribute to these sensations, notably the eyes and the viscera. We do not naturally refer the sensations to the semicircular canals. We simply find our equilibrium disturbed without localising the organ responsible for the sensation. Undoubtedly the cerebellum participates in the control of equilibratory movements and consequently in their misbehaviour.

The Qualities of Taste Sensations.—There are, without much question, four and only four elementary qualities of taste sensation, *i. e.,* sour, salt, sweet, and bitter. What we commonly call tastes are generally compounds, or fusions, of taste with temperature, pressure, and smell. Thus, as we have remarked at an earlier point, the characteristic taste of onions will be found astonishingly altered, if one close the nostrils firmly before taking the onion into the mouth. Some authorities incline to add two other elementary tastes to the list of gustatory qualities, *i. e.,* alkaline and metallic. But on the whole, it seems probable that these are compounds of the others already mentioned. Certainly it is remarkable to see how completely these four suffice to describe the true taste sensations, when we are given a large number of substances to test by taste alone, without knowing in advance what they are to be. To make this experiment satisfactorily, one must see to it that smell is absolutely ruled out, that the temperature of the substances is that of the mouth itself; and one must be careful not to confuse the cutaneous pricking, puckering effects of certain substances, which are not taste sensations at all, with the true taste quality. Furthermore, one must employ solutions to make the test, for many food substances produce characteristic contact sensations which we instantly recognise. Other facts will be mentioned in the next paragraph confirmatory of the view that these four qualities of taste are exhaustive of the elementary forms.

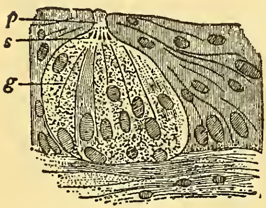

FIG. 38. Taste bud seen in the papilla foliata of a rabbit × 560 d. *g*, taste bud, showing outer supporting cells; *s*, fine ends of taste cells; *p*, taste pore. (McKendrick and Snodgrass after Stöhr.)

Neural and Physiological Basis of Taste.—The cells in the taste buds, found as a rule only in trough-like depressions about certain papillæ of the tongue (though occasionally elsewhere in the mouth), furnish us with our taste sensations. (Figure 38.) In order to get at these deep-lying cells the stimulus for taste has to be in fluid form. The end-organ cells are not true nerve cells, but are receptive and probably selective cells whose counterparts we shall find in the eye and ear. It seems probable that there is still further differentiation of the forms of this end-organ than is suggested by the mere existence of an end-organ cell; for certain regions, like the base of the tongue, are often especially sensitive to some one taste, in this case bitter. The sides of the tongue are particularly responsive to sour, the tip to sweet and to salt. The centre of the tongue is generally altogether insensitive to taste. The leaves of the plant called *gymnema sylvestre* will, if they be chewed, paralyse the sensitivity for bitter and sweet without affecting the other tastes. Cocaine, if applied to the tongue, causes first a loss of the ability to distinguish bitter, then sweet, and finally salt and sour. Furthermore, some substances, *e. g.*, saccharine, produce one taste in one part of the mouth, and another taste in another part of the mouth. Saccharine is sweet to the tip, and bitter to the base, of the tongue. All these facts are easy to explain, provided there are taste cells, which always respond, however they are stimulated, with some one taste quality. But the facts are not as yet definitely determined, and we must consequently eschew dogmatic statements.

The cortical centre for taste is not conclusively established. It is supposedly near that for smell.

It may be added that the sense of taste is well developed at birth, a fact which has, perhaps, a certain evolutionary significance. The sense is often defective in the feeble minded, a condition which suggests the readiness of animals to eat foods whose taste revolts the normal human being.

Olfactory Qualities.—It is impossible at the present time to say anything definite about the elementary sense qualities of smell. The evidence at present available would make it seem probable that the number is large. We seldom make any attempt at classifying odours by their sense qualities, probably because practical exigencies do not require it. Our only common classification is based upon the affective consequences of the odour stimuli, which we divide into the two great classes, agreeable and disagreeable. We designate odours by the objects from which they come, *e. g.*, violet, orange, leather, etc., adding occasionally to these terms metaphors borrowed from taste, *e. g.*, sour, sweet, terms which are not always applied unambiguously to the mere sense quality, but often involve reference to affective processes, and to other concomitant activities, both muscular and sensory. For example, a sour smell is often one which stirs up unpleasant gustatory sensations, with choking contractions of the throat. The classification most used in a practical way at the present time is Zwaardemaker's modification of Linnæus' table:

1—Ethereal smells, including fruit odours.

2—Aromatic smells, *e. g.*, camphor, spice.

3—Fragrant smells, *e. g.*, many flowers, violets, sweet peas, etc.

4—Ambrosiac smells, *e. g.*, musk.

5—Alliaceous smells, *e. g.*, garlic, chlorine.

6—Empyreumatic smells, *e. g.*, burning tobacco, burnt toast, coffee.

7—Hircine smells, *e. g.*, cheese.

8—Virulent smells, *e. g.*, opium.

9—Nauseous smells, *e. g.*, decaying animal matter.

This classification of the table has a purely practical value, however, and cannot be in any way accepted as representing the irreducible sense qualities.

Interesting efforts have been made to determine the relations of smell sensations to one another by the method of fatiguing the nose. For example, one smells of some substance until it ceases to be noticed, a condition which supervenes rapidly with many odours. Thereupon if other substances are inhaled, it will be found that some of them are clearly noticeable, whereas others are difficult to detect. It is assumed that those difficult to detect are similar in quality to the fatiguing odour. The results of this method are as yet very incomplete.

Physiological and Neural Basis of Smell.—The olfactory nerves terminate about the olfactory cells of the mucous membrane lining the upper portion of the nasal cavity. (Figures 39 and 40.) These cells are themselves true nerve cells. The cells of which we have spoken as possible receiving cells in the skin and tongue, are not themselves nerve cells. Those which receive the stimuli sent to the eye and ear were probably originally epithelial cells which have taken on neural functions. In this particular the olfactory cells are unique. Whether correctly or not, this fact that they are themselves nerve cells has been connected with the fact of their ready fatigue under stimulation.

Fig. 39. Isolated cells from the olfactory region of rabbit; *st*, supporting cells; *s*, short, stiff cilia, or, according to some authorities, cones of mucus resembling cilia; *r*, *r*, olfactory cells. The nerve process has been torn off the lower cell marked *r*. (McKendrick and Snodgrass after Stöhr.)

The cortical neurones which receive stimuli from the olfactory organs are in the hippocampal region, as may be seen by reverting to chapter II, figures 13 and 20.

In the human being the olfactory membrane lines the upper portion of the back of the nasal cavity, so that the air currents of our breathing do not normally affect it much. But if we inhale vigorously, the air is drawn higher up in this cavity and we at once obtain distinct odour sensations. The stimulus must be in very fine form, generally gaseous, in order to permit this result.

Genetic Features of Olfactory Sensations.—Smell is supposed to have developed later than taste and in air-breathing animals this is doubtless true of the sense in its present form. The most acute perceptions of smell are probably not obtained before seven years of age, because of mechanical difficulties in the form of the nostril. The abundance of mucus in infancy has a similar effect, producing obtuse smell sensitivities.

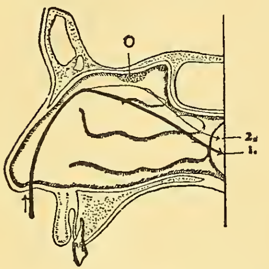

FIG. 40. Diagram to show the location of the olfactory end-organs and the course of the air currents when we breathe. *O*, the olfactory membrane into which the olfactory nerve comes down through the bone above. The black line numbered 1 indicates the usual course of the air in natural breathing. The lighter line numbered 2 indicates the course of the air when we inhale strongly. (Modified from Zwaardemaker.)

Analysis of Auditory Sensations: A. Noise and Tone.— —Our auditory sensations fall naturally into two great groups—noises and tones. But each of these can be subdivided again into a very large number of distinguishable qualities. The normal stimuli for hearing are air waves. The greater the amplitude of these waves, the louder the sound. We get the sensation qualities which we call noise when less than two complete vibrations of a sound wave are allowed to reach the ear; or, what is perhaps, owing to the reflection of the sound, the same thing, when the waves which do reach the ear are *irregular* and *non-periodic* in their mode of vibration. These irregularities may evidently be indefinite in number, and so we get such differences in the sounds as distinguish, for example, the noise of a train from the noise of a drum. These last mentioned cases, however, are what are called complex noises, and are conceived as made up of aggregations of the simple noises first mentioned, of which we can detect some 550 or more. The sensation of tone comes from bodies which vibrate *periodically* and *regularly,* like the pendulum. Such bodies are represented best by tuning-forks. We can distinguish some 11,000 simple tonal qualities. The differences among these qualities are primarily what we call differences in pitch. These arise from differences in the *vibration rates* of the sounds. We can hear tones ranging in vibration rate from 16 to 50,000 per second. The great majority of musical experiences arise from tones whose vibration rates fall between 64 and 5000. In the central region of the musical scale, *i. e.,* with vibrations ranging from 500 to 1000, keen observers can detect variations in pitch of only one-fifth of a vibration.

The tonal element in noise is easily discernible in the differences in pitch which are often manifest. The roar of a freight train crossing a bridge is much deeper than the rattle of a dray on a street pavement. Practically all the sounds which we hear are combinations of tone and noise. The human voice is an excellent example of this fact. In enunciating words the vowel sounds represent the tonal element, the consonants the noises.

It must be remembered that the musical tones which we commonly hear are not simple, but complex, being constituted of a number of tones—the fundamental and its overtones. The nature, number, and relative intensity of these partial tones determines the timbre of a sound. The characteristic differences in the tone quality of different instruments have this fact as their basis. In the piano, for instance, there is a rich and well-balanced set of the lower partial tones. In the clarinet the odd overtones are predominant; in the flute these particular overtones are few and weak, etc. The evidence for these facts is not easily obtained without the use of apparatus.

The fact that we can analyse complex tones so that we become clearly conscious of their partial tones, as well as our capacity to remark the constituent notes in a chord or other group of tones is one of the remarkable things about audition. We shall connect this fact conjecturally with the construction of the internal ear when we come to speak about the end-organ.

It is evidently possible to connect certain of the more fundamental attributes of sound sensations with their physical antecedents. Arranging them in pairs we have: tone = periodic vibration; noise = non-periodic vibration; pitch = vibration rate; intensity = amplitude of vibration; tone quality = vibration composition.

B. Combination Tones.—When two tones occur together under certain conditions several additional tones are heard. These supplementary tones are known as combination tones and are divided into difference tones (of the first, second and higher orders), and summation tones. Difference tones of the first order correspond in vibration rate to the difference between the vibration rates of the generating tones. Those of the second order correspond to tones whose vibration rates are equal to twice the rate of the lower generator minus that of the higher.* The summation tones correspond to tones with vibration rates equal to the sum of the rates of the prime tones. These combination tones are not ordinarily noticed by lay observers, but they are often very powerful and undoubtedly contribute to produce certain important musical effects, *e. g.,* in the minor chords. The theories of their production are too numerous and too unsettled to warrant discussion. It may be that the tones are ordinarily objective (extra-organic) and physical in origin instead of subjective and physiological (intra-organic), as has generally been supposed: or it may prove that sometimes they are objective, sometimes subjective, and sometimes both.

C. Consonance and Dissonance.—The consonance and dissonance of tones has long been a subject of psychological perplexity. Certain tones (*e. g.,* C and G on the piano)

* Description of the higher orders is omitted.

fuse with one another, that is to say they lose their individual distinctness. Other tones (*e. g.*, C and C♯) refuse to fuse and are harsh and discordant in their effects upon us. These tonal complexes are generally marked with strong feeling-tone. They are agreeable or disagreeable. On this account we shall defer further discussion of them until we take up the elementary æsthetic feelings.

Genetic Features of Audition.—We have once before called attention to the fact that, owing to the presence of mucus in the middle and external ear, the new-born child is generally insensitive to ordinary sounds. The position of

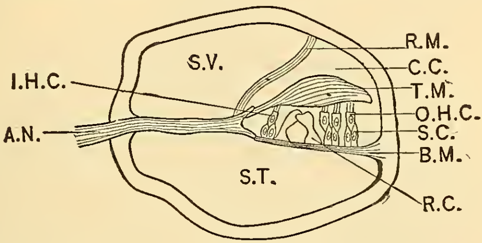

Fig. 41. Diagram of the cochlea seen in transverse section. *S. T.*, the scala tympani; *S. V.*, the scala vestibuli; *C. C.*, the canal of the cochlea; *A. N.*, the auditory nerve running out through the bone to join the canal of the cochlea; *B. M.*, the basilar membrane; *R. M.*, Reisner's membrane; *T. M.*, tectorial membrane; *I. H. C.*, inner row of hair cells; *O. H. C.*, outer row of hair cells; *S. C.*, supporting cells; *R. C.*, rods of Corti. (Modified from Stewart.)

the drum membrane also contributes to this insensitivity. About four days after birth most children will show response to loud sounds by expressions of fright. The sensitivity to high-pitched sounds seems to develop sooner than that to low sounds. Localisation of sounds seems to begin with many children at about four months of age. Children a year and more of age are often extremely sensitive to very weak sounds which older persons cannot hear at all.

Neural and Physiological Facts of Audition.—The auditory nerves terminate about the bases of hair cells in the internal ear, such as appear in figures 41 and 42. These cells are immersed in liquid contained by the sac-like membranes of the inner ear. Figure 43 will make evident the relations to one another of the internal, middle, and external ear. The external ear gathers up the sound waves and focusses them upon the drum membrane of the middle ear. The middle ear contains a chain of small bones stretching between the membrane just mentioned and another smaller membrane on the side of the inner ear. The Eustachian tube comes up from the throat into this middle ear cavity, and whenever we swallow allows air to enter from the throat,

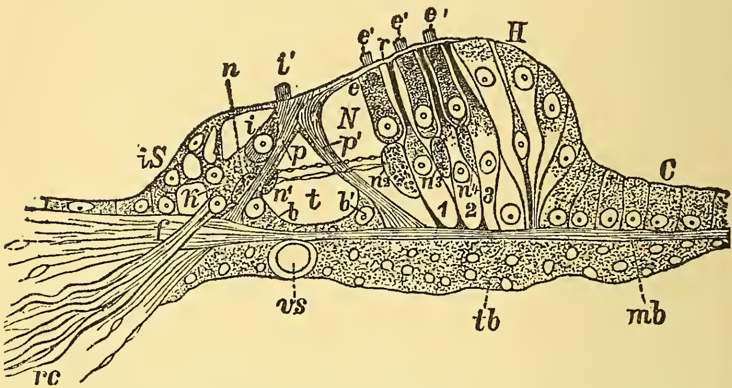

Fig. 42. Cross section of the organ of Corti; *p and* p^1, internal and external rods of Corti; *i* and i^1, internal hair cells; e^1, external hair cells; *mb*, basilar membrane; *rc*, nerve fibres leading from the hair cells inward to the central nervous system. (Barker after Retzius and Rauber.)

thus keeping the air pressure in the middle ear like that outside. If the pressure were uneven on the two sides, the membrane would be stiffly bulged out or in and could not operate sensitively to impacts of sound waves. The bones and membranes of the middle ear have been supposed to multiply the power of the vibrations they transmit to the inner ear, thus enabling the relatively feeble sound waves in the air to set up vibrations in the liquids of the inner ear. (They form a powerful lever system and the receiving membrane has a much larger surface than the delivering membrane.) But the discovery of cases in which the mechanisms of the middle ear have been destroyed without seriously impairing hearing, renders it possible that their function is more protective and less purely acoustical than has been supposed. At all events they do not appear to be indispensable.

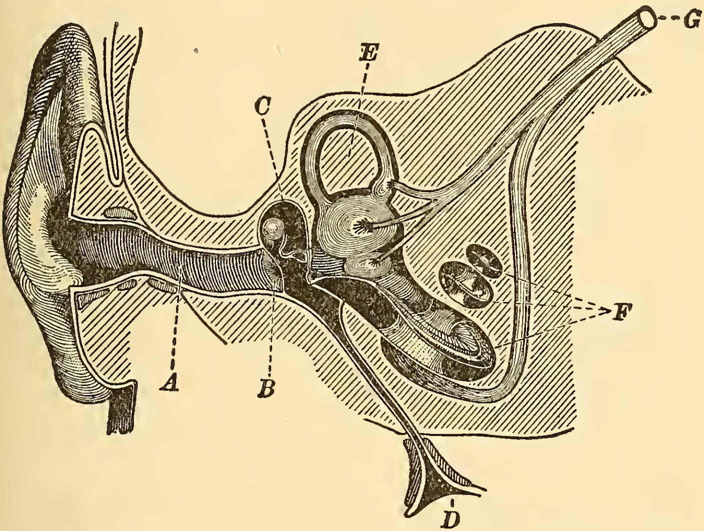

Fig. 43. Diagram of the ear. *A*, auditory canal of the external ear; *B*, tympanic membrane separating the external from the middle ear, *C*; *D*, Eustachian tube leading from the middle ear to the throat; *E*, one of the semicircular canals of the internal ear, arising out of the utricle upon which, as upon the adjacent saccule, fibres from the vestibular branch of the eighth nerve are shown terminating; *F*, the spiral of the cochlea, through the central pillar of which the auditory nerve is shown entering to spread out toward the hair cells of the cochlea canal, as indicated in figures 41, 42; *G*, the main trunk of the eighth nerve. (After Hough and Sedgwick.)

There are many thousands of the hair cells of the inner ear, and the precise mode of their stimulation is still problematic, despite the numerous explanatory theories in the field.

The cells are mounted chiefly on the sides of the rods of Corti, which form a triangular tunnel as may be seen in figures 41 and 42. These rods rest on the fibres of the basilar membrane which forms the floor of the tunnel and coils about 2.5 times in the spiral cavity of the cochlea. The membrane is considerably broader at the top than at the bottom, so that it affords a series of stretched strings of different lengths like the strings of a harp. It has been generally supposed, following the authority of Helmholtz, that these fibres, or groups of them, could respond 'sympathetically' when a tone was sounded corresponding to their own natural rate of vibration.* The movement of the fibre was supposed to stimulate the cells resting upon it, whereupon the cerebral cortex would presently receive an excitation peculiar to the given tone and different from every other. The fact that the ear can analyse complex tones was referred to this stimulation of special fibres by each element of such complexes.

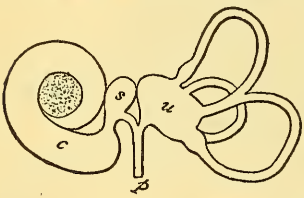

FIG. 44. Membranous labyrinth (diagrammatic). *c*, cochlea; *s*, saccule united by *p*, the ductus endolymphaticus, with *u*, the utricle, arising from which are seen the three semicircular canals. (After McKendrick and Snodgrass.)

Tone deafness and the existence of 'tone islands' suggest the correctness of some such theory as the above. Certain persons cannot distinguish any change in pitch over considerable ranges of the scale. This is easily explicable on the basis of the Helmholtz theory, if certain fibres of the basilar membrane are for any reason incapacitated.

Of late many difficulties have been encountered which the

* If one press gently down a key on a piano and then sing the tone corresponding to the key, the string belonging to the key will be heard giving out the tone which it has taken up 'sympathetically'.

theory has hardly met successfully. These are physical, physiological, and psychological. But we cannot go into them. Suffice it to say that the facts at present known render it probable that the analysis of tones, however this be brought about, is performed by the mechanisms of the internal ear rather than by the cortex as has been suggested.

The cortical centres for audition have already been sufficiently described in chapter II.

The semicircular canals of the internal ear (figures 43, 44) also contain sensory fibres, which terminate, like the true auditory fibres, about the bases of hair cells. The fluid in the canals contains little calcareous particles called otoliths. When the body moves in any given direction some of these otoliths are supposed to lag behind, because of their inertia, thus striking the hair cell filaments and setting up a sensory disturbance. As the canals are at right angles to one another, the fluids of some one or two of them would always be most affected by a single movement, and the sensory excitations arising from them might thus be connected either reflexly or by experience with specific kinds of movements, *e. g.*, forward, backward, upward, etc.

Of the cerebral cortical regions possibly involved in the activity of these canals nothing specific is known, beyond whatever is included in the disturbance of other sensory processes like vision, whose representation in the cortex is determined. It is known, however, that the cerebellum is engaged in their operation.

Analysis of Visual Sensations.—Like the auditory sensations, our visual sensations fall into two general classes—sensations of brightness and sensations of colour. The brightness sensations are caused by the impingement upon the retina of *mixed* light waves of *various* lengths; thus, what we call white light is made up of light waves of all lengths. Pure colour sensations are produced by *homogeneous* light waves, or waves of practically *equal length*. The more homogeneous these waves, the more saturated, the purer, the color. As a matter of fact, we never experience colours without getting a measure of brightness sensation also. Although it is convenient to distinguish the two forms of sensation from one another, this concomitance must not be forgotten. Under ordinary conditions the brightest region of the spectrum is in the yellow. If the illumination of the spectrum be sufficiently lowered, the region of maximum brightness will be transferred from the yellow to the green; and the red end of the spectrum will become relatively darker in colour-tone while the blue end becomes lighter. This phenomenon is known after its discoverer as the Purkinje phenomenon.

As in the case of sound, the *intensity* of the sensations parallels the *amplitude* of the light wave. If we gradually decrease the intensity of white light, we pass first through a series of shades, to which we should ordinarily apply the name grey, and come finally to black. Black and white are thus the extremes of the brightness series of sensations, and between them occur the various shades of grey. Black is a relative term applicable to great contrasts with white. The retina is itself always active, so that even in perfect darkness we see floating clouds of dim 'idio-retinal' light. We are able to distinguish some 700 different brightness qualities between the deepest black and the most brilliant white.

We are in the habit of referring to the spectral colours, or qualities, as being seven in number, *i. e.,* red, orange, yellow, green, blue, indigo-blue, and violet. This is, however, a merely practical and somewhat arbitrary division. These names apply to distinctions in colour tone which we promptly and easily remark when looking at a sunlight spectrum. But in reality the colour between pure green and pure blue is just as truly entitled to a separate name as is orange, a colour which distinctly suggests both red and yellow. Purple, too, which can be formed by mixing red and violet, the colours at the ends of the spectrum, is a perfectly genuine colour quality, deserving to rank in this respect with the spectrum colours themselves. When we are given proper experimental conditions we find we can distinguish some 150 spectral qualities. This includes the purple.

Some 30,000 distinguishable qualities can be produced by combining the several spectral qualities (150) with the brightness qualities (700). Thus red, for example, can be mixed with white to produce various tints, which we call pink; or with black to produce various shades, which we designate brown. Figure 45 displays in a general way these relations.

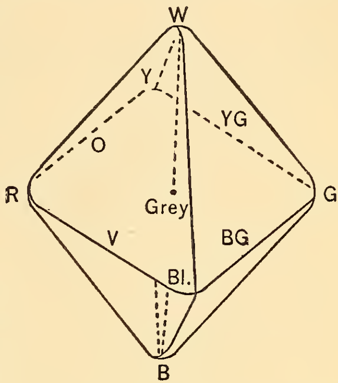

Fig. 45. The colour pyramid. The line *WB* corresponds to the white-black series of colours; the plane *Bl.RYG* represents the most saturated spectral colours, *e. g.*, blue, red, green. The lines joining *W* and *B* with the letters representing the several spectral colours, *e. g.*, *Bl.* and *G*, illustrate the transitional tints and shades. (After Ebbinghaus.)

Elementary Colour Relations: (1) Mixtures and Complementaries.—If we now apply to vision the mode of analysis we have employed heretofore in the case of other sensations, and attempt to reduce the visual spectral qualities, apart from brightness, to those which seem really elementary, we shall find four such colours remaining, *i. e.*, red, yellow, green, and blue. All the others, when closely inspected, appear to us to be compounds. Orange, we have already remarked, appears both reddish and yellowish. Violet has traces both of blue and red, and so with all the transitional hues leading from one of these elementary colours to another. Moreover, if we be given these four colours, we can, as we should naturally expect, produce all the other spectral hues by mixing these elements in proper proportions. Among the mixtures which we can make in this way are certain very peculiar ones, which result when we take two such colours as yellow and blue, or red and blue-green. These pairs of colours, when mixed together, give us, instead of a new spectral hue, simply grey. Colours whose mixture results thus in grey are called complementary colours, and every colour has some complementary in the spectral series, except green, whose complementary is purple, a mixture of red and blue. (Figure 46 shows these relations.)

(2) **After-Images.**—Our visual sensations are in one particular very remarkable, as compared with our sensations of other kinds. The obvious after-effects of sensory stimulation last longer and are more peculiar than is generally the case elsewhere. Neglecting minor variations, there are two principal forms of after-images, as they are called, *i. e.,* positive and negative. After-sensations would, perhaps, be the better term for them. If one suddenly looks at a very bright light, and then closes the eyes, the light continues to be seen for some seconds in approximately its proper intensity and hue. This phenomenon is a positive after-image. If one looks for a few seconds fixedly at a bit of blue paper, and then closes the eyes, or turns them upon some neutral grey back-ground, one sees a yellow patch corresponding in shape to the blue stimulus. This is a negative image. Negative images invert the relations of brightness in the stimulus, so that what was white in the object appears black in the after-image, and vice versa. They also convert all spectral colours and their compounds into their several complementaries. While all the senses display after-effects similar to the positive visual after-image, none of them has anything *precisely* comparable with the negative image.

(3) **Colour Contrast.**—The phenomena of contrast also, although characterising in a measure all sense domains, and for that matter all conscious processes, are especially striking

in vision. Yellow and blue appear respectively yellower and bluer, when seen side by side, than when seen apart. This seems to be largely because of the fact that the eye moves slightly from one to the other; and the eye fatigued for blue already has a disposition to react with the yellow after-image. If the part of the retina containing this yellow after-image process is then exposed to the real *objective* yellow, the power of the stimulus is much enhanced, and we see a deeper, more intense yellow than we otherwise should. This

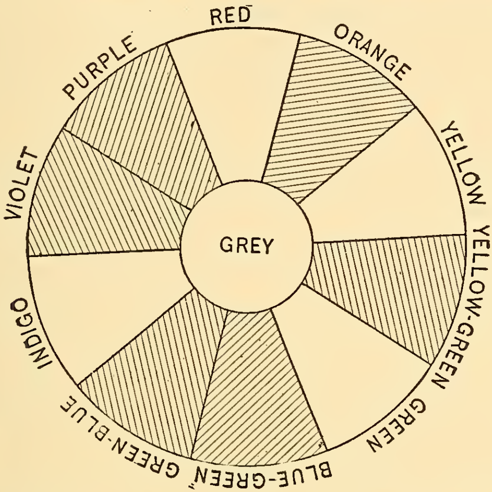

FIG. 46. The colours at opposite ends of any diameter of the circle produce grey, if mixed with one another. Purple, which is the complementary colour to green, is not found in the spectrum, but is produced by a mixture of the end-colours of the spectrum, red and violet. Colours opposite blank segments are psychologically pure and elementary. Colours opposite shaded segments are composite.

phenomenon is called successive contrast. Simultaneous contrast is an even more interesting phenomenon, and may be illustrated by putting a small bit of grey paper upon any coloured field, and then covering the whole with thin white tissue paper. The grey patch will, under such conditions, always appear as of a colour complementary to that of the field, *i. e.,* it will appear blue when the field is yellow; yellow, when it is blue; reddish when it is green, etc. The explanations offered for this phenomenon would take us too far into physiological psychology, and we must rest content with the general conclusion that our colour sensations are dependent, not only upon the colour of the object immediately fixated, but also upon the colours surrounding it, and upon the immediately preceding stimulation.

(4) Defects in Colour Vision.—Finally, we may remark, that the peripheral portions of the retina are seriously defective in their colour reactions. Accurate colour vision belongs only to the central portion of the retina around the fovea. According to most observers, red and green are only seen accurately for a short distance outside this region. Yellow and blue are lost next, and in the extreme periphery all colours appear white or grey. This condition suggests the pathological colour-blindness from which many persons suffer even at the fovea. Recent investigations indicate that possibly all the spectral colours can be seen at the periphery, provided their intensity be sufficient. These observations imply the existence of colour weakness in the marginal regions of the retina, rather than true colour-blindness.

Pathological Colour Blindness.—Colour-blindness is sometimes, but very rarely, total. The patient sees all colours as white, grey, or black. Two types of partial colour-blindness are recognised, the one red-green blindness with two subordinate forms, and the other blue-yellow blindness. In red-green blindness the spectrum is seen as half yellow and half blue. The quality of the yellow or blue changes with the region of the spectrum observed. In one type of this form of blindness the greatest brightness of colour is seen in the pure yellow, and the red end of the spectrum is relatively bright. The other type finds the brightest colour in yellow-green, and sees the red end of the spectrum relatively dark.

In both types a neutral grey band is seen between the blue and the yellow regions of the spectrum. In blue-yellow blindness the violet end of the spectrum is dark and little saturated. Yellow and white are confused. This classification is Hering's. It should be added that many persons are slightly defective in their colour vision without properly belonging in the group of the colour blind.

Theories of Colour Vision.—Of the many theories of colour vision that of Helmholtz is probably most widely known, although it is quite certainly untenable. It assumes three fundamental colours, red, green, and violet, by combinations of which all the other colours including white are produced. For example, red and green will produce yellow; red and violet, purple; and all three elementary colours taken together will produce white. It explains the facts of colour mixture well, but it is unable to account for the psychological simplicity of blue and yellow, which do not seem to us compounded of other colours. Orange, for instance, instantly suggests to us the red and yellow of which it is composed. The facts of colour-blindness, to mention nothing further, are inexplicable by it.

Hering's theory is at present probably most widely held. It assumes three fundamental pairs of colours, white-black, blue-yellow, and green-red. These pairs are in relations of opposition to one another such that if one member of a group be stimulated, the other member must become active before the equilibrium of the retina is restored. The black-white substance is always stimulated by light of every kind and it is evolutionarily the oldest, red-green being the most recently acquired. Mixtures, complementary effects and after-images can all be accounted for by the theory. Mixtures are explained as in the Helmholtz theory. The positive after-image results from the continuation of the effect of the stimulus. The negative image arises from the activity of the colour processes antagonistic to those aroused by the stimulus. Complementary colours simply offset one another and leave the grey of the black-white process. Unfortunately the green which is the complementary of spectral red is not pure green, as it apparently should be, but blue-green and there are some other difficulties too technical to discuss here, which render the theory imperfectly satisfactory.

The theory at present apparently most adequate to the various facts is that of Mrs. Ladd-Franklin, although scholars have not generally conceded its truth.

Mrs. Franklin assumes that the retina originally responded only to differences in brightness. The outer region of the retina is still in this condition as are probably the retinæ of certain of the lower animals. The conscious quality corresponding to this stimulus is grey. In the course of evolution the chemical substance which originally gave rise to sensations of grey only, has been diffentiated so that the various spectral colours produce partial disintegration of it and lead to the sensations which we now see from red to violet. The first differentiation which took place corresponded to the colours blue and yellow, and we consequently can see these hues farther out on the retina than red and green, for which sensitivity was later evolved. The yellow process is supposed to differentiate into red and green. The blue has remained relatively unchanged. The grey of complementary colours is explained by the entire distintegration of the original visual substance by the summative effects of the partial disintegrations which have been evolved from it. Thus when yellow and blue are mixed, each colour disintegrates a portion of the original visual substance, and together they effect a complete disintegration of it. The facts of colour mixtures can be explained much as in other theories. Contrast phenomena are due to the progressive break down of the chemical substance assisted in certain cases by the circulation.

Although in this account emphasis has been laid upon the genetic aspects of the theory, Mrs. Franklin regards these considerations rather as confirmatory of her view than as

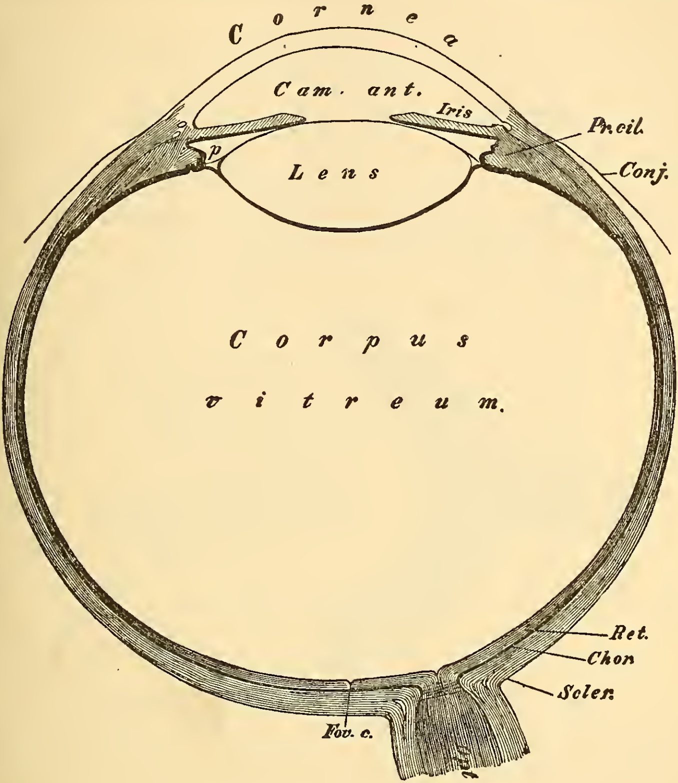

FIG. 47. *Opt.*, optic nerve; *Fov. c.*, fovea centralis; *Scler.*, sclerotic; *Chor.*, choroid; *Ret.*, retina; *Conj.*, conjunctiva; *Pr. cil.*, ciliary processes by means of which lens is adjusted; *Cam. ant.*, anterior chamber filled with aqueous humour; *p*, posterior chamber. Just below *p* the capsule and ligament supporting the lens are shown attached to the ciliary processes. *Corpus vitreum*, the vitreous humour of the main cavity of the eye-ball.

affording it a foundation. She starts from the fundamental and immediate facts of colour vision, such, for example, as the basic differences in quality among the colours red, yellow, green and blue.

Physiological and Neural Basis of Vision: A. The Eye-ball.—The essential anatomical facts about the eye are shown in figures 47 and 48. The eye is a small spherically shaped dark-room, the inner walls of which are covered with the sensitive retinal membrane. Light is admitted to this membrane through the aperture in the iris. The light passes first through the transparent spherical cornea where it is refracted (figures 47 and 50); then into the anterior chamber filled with a clear fluid known as the 'aqueous humour,' thence through the lens where it is again refracted, so that it may form a perfect image on the retina, after which it passes through the 'vitreous humour,' thus finally reaching the retina where it sets up neural changes that are transmitted to the cerebral cortex.

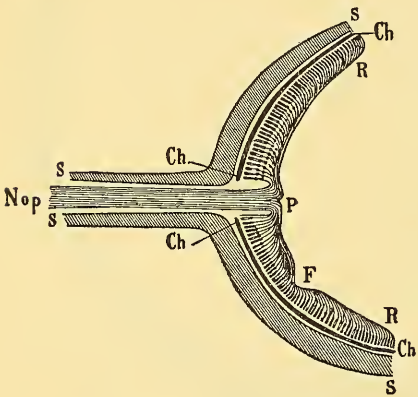

FIG. 48. Scheme of retinal fibres. (James after Kuss.) *Nop*, optic nerve; *S*, sclerotic; *Ch*, choroid; *R*, retina; *P*, papilla (blind spot, where no retinal structure is found); *F*, fovea.

The eye has a tough, thick outer coat, the sclerotic, to which are attached the large muscles that move it. Inside the sclerotic is another membrane, the choroid, which carries blood vessels and is provided with a dense, dark pigment that renders the inside of the eye essentially impervious to all light, save that which comes through the opening in the iris. Inside the choroid again is the retina itself, shown in figures 48 and 49. By contracting and expanding, the iris alters the amount of light admitted in such a way as to best serve clear vision. In dim lights it expands to allow entrance to more light, in bright lights it contracts.

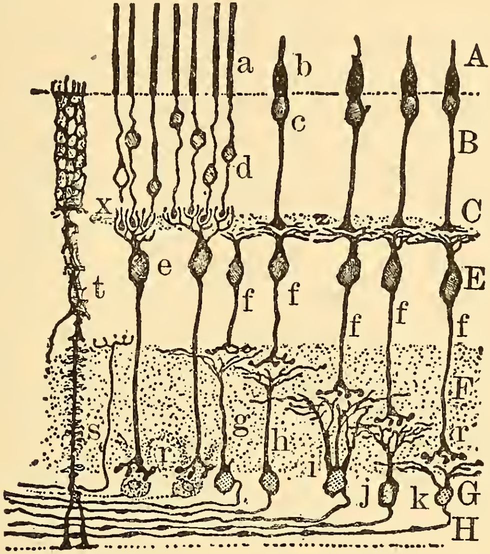

FIG. 49. Scheme of the structure of the retina. *A*, layer of rods and cones; *a*, rods; *b*, cones; *E*, layer of bipolar cells; *G*, layer of large ganglion cells; *H*, layer of nerve fibres; *s*, centrifugal nerve fibre. (Barker after Ramón y Cajal.)

B. Convergence and Accommodation.—By means of six muscles which are attached to the external surfaces of each eye we are enabled to direct them toward any object at which we may wish to look. This process is convergence, or divergence, as the case may be. By means of the lens in each eye, which can be made more or less convex, the rays of light from the object at which we are looking are brought to a focus upon the so-called *fovea centralis,* the central spot of the retina and the point of clearest vision; and thus we secure a clear, well-defined image upon each retina. This act is called accommodation.

The cornea also plays an important part in bending the light rays into the proper directions for clear vision and it is to defects in the sphericity of its surfaces that astigmatism is generally due. The rays coming from a perpendicular line, for example, may be bent more sharply than those coming from a horizontal line. In consequence they cannot both be seen clearly at once. If one is properly accommodated for, the other will have its light rays focussed either in front of, or behind, the retina. Short sightedness and far sightedness are ordinarily due to faulty form of the eyeball or the lens. Rays of light instead of coming to a focus on the retina, do so in front of, or behind, its surface, so that the images are blurred and indistinct. Lenses or prisms put in front of the cornea are used to offset these accommodatory defects. (Figure 50.) Sometimes the muscles which move the eye-balls are not well balanced in power and then prisms may be used to lessen the work done by the weak muscles.

C. **The Retina.**—The retina, which differs from all the other sense organs in being in reality a part of the brain removed by growth from its original location, contains a most elaborate series of structures. These are shown in figure 49. The optic nerves enter from the back of each eyeball, and the nerve fibres are then distributed radially all over the spherical surfaces of the eyes, as far forward as the lens. (Figures 47, 48.) The fibres turn backward, away from the centre of the eye, and lose themselves among the basal cells of the retinal structure. The light waves make their way in through the dioptric media of the eye, as already described, and finally, *after* passing through the transparent optic fibres, come to the retinal end-organs, the rods and cones. (Figures 47 to 49.) At this point the physical ether vibrations which we call light set up physiological changes in the nerve, and the nervous current runs backward along the nerve fibres, and so to the brain.

At the point where the optic nerve enters the cup of the eye there is no retinal membrane. This is the blind spot. (Figure 48.) It is slightly nasalward from the fovea and its presence can easily be demonstrated by placing two dots three inches apart on a sheet of paper. By closing the left

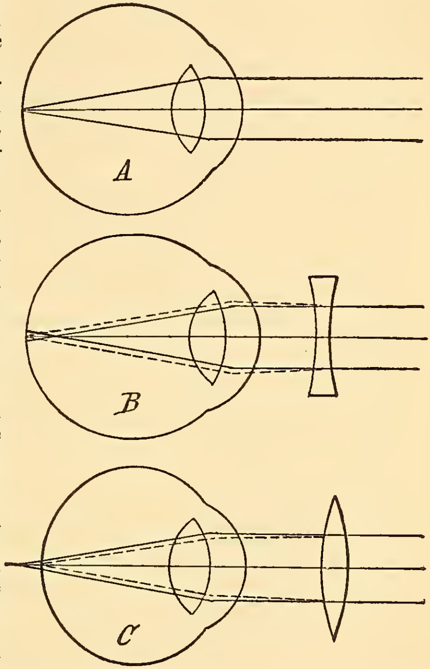

FIG. 50. Diagram showing difference between normal (*A*), myopic or near-sighted (*B*) and hypermetropic or far-sighted (*C*) eyes. In *A* rays of light from objects at a distance come to a focus precisely upon the retinal surface. In *B* they come to a focus too soon and are diverging again when they reach the retina. In *C* they do not come to a focus until after they have passed beyond the retina. In *B* and *C* the dotted lines represent the course of rays after correction by glasses put in front of the eyes. The diagram may also serve to illustrate astigmatism by supposing that the lines in *A* represent the vertical rays from an object, which in such a case come to a focus properly on the retina, while those in *B* or *C* represent the horizontal rays which come to a focus either in front of, or behind the retina. In such an instance it is evident that objects would be seen blurred in all diameters other than those which come to a focus on the retina, as do the vertical ones. (After Howell.)

eye and looking at the left-hand dot, while moving the paper to and from the face, a position will be found where the second dot wholly disappears.

The retina responds to vibration rates of ether between

440 trillion and 790 trillion per second. These are the rates of the light waves of the visible spectrum of the sun.

The rods and cones are distributed differently over the retinal surface. The cones are in exclusive possession of the foveal depression, the point of clearest vision. They decrease in number and are gradually displaced by the rods as we pass toward the periphery of the retina, until at the extreme forward limits of that membrane the rods alone are found. There is not a little evidence to indicate that the rods mediate only brightness sensations and that their most important functions are perhaps connected with vision in dim lights.* Certain it is that we are often able to notice faint lights with the periphery of the eye, where they are numerous, which are not visible at the fovea. This can be demonstrated upon faint stars. It is often noticed at sea where the lights of distant vessels can be thus discerned when invisible to direct vision. The cones are probably then the important organs for colour vision.

The cortical centres for vision in the occipital lobes have already been described at some length in chapter II.

* The rods contain a substance known as 'visual purple' which bleaches rapidly under the influence of light. It has been suggested that the Purkinje phenomenon, mentioned in an earlier paragraph, may find its explanation in the way in which this visual purple affects the retinal action of coloured light. This substance is bleached most rapidly by green light, a trifle less rapidly by blue light, and least rapidly by red light. The colours at the red end of the spectrum may consequently produce less retinal effect on the visual processes in the rods, than do those at the blue end. On the basis of a theory such as that of Mrs. Ladd-Franklin, this fact should result in decreasing the relative brightness of the red end of the spectrum. According to this theory, sensations of brightness are occasioned by the disintegration of the primitive colour molecule found in the rods. As the green and blue rays would operate more effectively on the retina in dim lights than the red rays, they would break down this molecule more rapidly and vigorously, and the resulting brightness sensations would be more intense. Thus the blue end of the spectrum would appear brighter than the red end. The fact that the Purkinje phenomenon is said not to be present in foveal vision, and the further fact that the operation of the visual purple is practically confined to vision in dim lights, would tend to confirm such an explanation as this.

Genetic Facts of Vision.—The retina is well developed at birth, and some children apparently have a slight control over the movements of fixation at birth. This is, however, rare, and such control generally does not come until the third week. But there is much variation. Older children surpass adults in their ability to see in a dim light, and to see small objects at a distance. This is probably because the optical media, *e. g.*, the humours of the eye, etc., are with them more transparent. The colour sense is often apparently defective in children. But this probably means simply a lack of *experience* in distinguishing colours. The brighter colours are generally preferred. Genuine colour blindness is extremely rare among girls, whereas perhaps one in every twenty-five or thirty boys is defective.

Summary of Sensation Qualities.—After our analysis of the several types of sensation we may now bring together certain of our results in numerical form. If we consider only the irreducible sense qualities, like redness and sweetness, abstractly considered, and call these the sensation elements, we have probably not more than 20 or 25 when smell and sound are left out of the count. The problem of reduction to simple sense forms is, in the case of these last two groups of sensations, fraught with great difficulty and uncertainty. But if we take into account the actual *concrete* sensory qualities as we find them, *e. g.*, red combined with a given brightness, we are supplied with more than 42,000 distinguishable qualities. This latter figure again disregards smell, about which no confident statement can be made.

General Characteristic of the Sensation Quality.—The fundamental characteristic common to all the sensations is a certain something which they occasion in us, for which *shock* is possibly the most appropriate name. This characterises all *transition* in consciousness, and especially consciousness of immediate sense activities.

The Intensity of Sensations.—We have remarked incident-ally a number of times in this chapter, that our sensations originate from the stimulation of specific sense-organs by some form of motion in the physical world about us, such, for example, as the air waves, the ether waves, the heat waves, etc. But it is not only necessary that these various forms of stimuli should fall upon the sense organs. It is also necessary that they should possess sufficient intensity, if we are to become conscious of them. A very faint light, a very faint sound, a very faint odour, may fail altogether to produce a sensation in us. The point at which such a stimulus becomes intense enough to produce a sensation is called the limen, or the threshold. It is also a matter of frequent observation that when sensory stimuli become very intense, they cease to be felt as they were before, and we experience pain instead. A very bright and blinding light may cause acute pain. A loud, shrill sound, extreme heat, and extreme cold are all painful. The point at which the various stimuli are thus felt as painful is known as the *upper limit* of sensation. Between the limen and the upper limit fall an indefinite number of gradations of sensory intensities. It should be noted in passing, that certain olfactory and gustatory stimuli can hardly be obtained in sufficient intensity to be called painful; and also that many very weak sensations are unpleasant, *e. g.*, weak sounds and faint lights, the tickling from delicate contact, etc.

Weber's Law.—Exhaustive experiments have revealed a very interesting law, known after its first careful investigator as "Weber's Law," which obtains among the relations of these sensation intensities, as we experience them. When we place a weight of 20 grams upon the hand, we find that we observe no change in the pressure sensation until a whole gram has been added to the 20. If we take 100 grams, we must add 5 grams before we can observe the change in intensity; and, speaking generally, whatever absolute weight we start with, we find always that we must add the same fraction of its own weight, that is, 1-20, in order to feel that the pressure has changed. A similar thing holds true of the intensity of sounds, but in this case the fraction is approximately 1-3. In sensations of brightness the change must be 1-100, etc. In all these cases the formula is most nearly true in the medium ranges of intensity. When we approach the limen or the upper limit, the relations seem to become irregular, and in the case of certain senses, like smell, the application of the law is somewhat dubious.

Duration of Sensations.—We have seen that every stimulus must possess a definite intensity before it can give rise to a sensation; and it is even more obvious that every such stimulus must also possess a certain duration, if it is to be felt. Moreover, many sensations are very profoundly altered by prolonged duration. Thus, colour sensations will be found to grow dim and to fade, if long continued. Some sensations of sound, on the other hand, seem to become more intense, if continued, and finally occasion pain. The detailed facts about the influence of duration upon sensory processes cannot at present be both accurately and briefly set forth, and we shall therefore pass them by.

Extensity in Sensations.—Certain sensations, like those of vision and touch, always possess, in addition to the previously mentioned characteristics of duration and intensity, a definite quality of extensity. Some distinguished psychological authorities insist that all sensations are thus extensive or voluminous, sensations of sound and smell and taste, as well as those of touch and sight. This is not, however, the prevalent view, and we shall not discuss the matter here. It will be considered in the chapter on space. Suffice it to say, that a colour sensation cannot exist at all without being experienced as possessing extensity. The same thing is true of pressure; and, in general, all sensations which *ever* possess the quality of extensity *always* possess it, just as they possess duration and intensity. The kinæsthetic sensations are admitted by all psychologists to belong, with pressure, temperature, and vision, to the spatial senses.

The Attributes of Sensation.—If we bring together the points we have gone over in discussing the quality, extensity, duration, and intensity of sensations, we shall see that quality is, in a definite sense, the most fundamental thing about a sensation, and that the other characteristics can fairly be regarded, for our psychological purposes, as subordinate attributes of quality. Thus, a given musical tone may last one second, or three, without essential change in the pitch, which is its quality, psychologically speaking. It may be louder, or softer, without changing its pitch. Furthermore, it may change its timbre, which seems to be a sort of secondary quality, by changing its overtones, and still retain its pitch, or primary quality, unaltered. Similarly, a sensation of red may come from an object one inch square, or from one two inches square, without noticeably changing the hue of the colour, although if it be made sufficiently small, the colour cannot be detected. Nevertheless, it must be recognised that if any one of these attributes becomes zero, the whole sensation disappears. A sensation lacking either duration or intensity, for instance, is no sensation at all. The term 'attribute' is consequently not without ambiguity in this connection.

Functions of Sensory Processes: (1) Instigation of Movements.—From the physiological side it is evident that the primary organic function of the sensory processes must be that of instigating movements. In chapter III, we examined certain typical instances, in which we found these processes operating to produce movements, and then further operating to report the results of the movements, thus assisting in the establishment of useful coördinations. When we say that sensory stimulation instigates movements, we must not make too sharp a distinction between the stimulation, as sensed, and the movement, when a response is made without deliberation. The nervous process is practically a *continuous* progress of impulses from the sense organs clear around to the muscles. There is nowhere any essential break in this feature of the activity. The *act* is literally a unit.

Similarly, if we examine the facts closely, we shall see that on the psychological side the sensory reaction is simply the registration in consciousness of a certain kind of act, and that it varies markedly with the sort of response that is executed by the muscles. A *sensation* of a disagreeable odour produces not only consciousness of a certain kind of olfactory quality; it produces also the consciousness of tendencies to movement, *e. g.*, choking movements in the throat, violent expiratory movements, movements of the head away from the source of the odour, etc. The sensation of the odour is instantly merged with other sensations which these movements call out, and is markedly modified by them. Furthermore, the kind of sensation which we get from an odour in the first instance will be determined intensively at least by the kind of movement in progress at the moment when we come into contact with the stimulus. If we are not expecting the odour, our breathing may be free and deep. In consequence, we obtain a deep inhalation of the noxious fumes, and from the blending of this impression with the ongoing mental activity, one kind of sensation results. If we are expecting the odour, or if our breathing happens momentarily to be superficial, the sensation is much modified and weakened. So we see that our consciousness of sensory stimuli is qualified on both sides by movements, *i. e.*, by those movements which lead up to it, and by those which follow it.

(2) **Source of the Material of Knowledge.**—Many psychologists define sensation as the *consciousness of the qualities of the objects* (*including the body*) *stimulating the sense organs.* These qualities which we have been describing in the present chapter, *e. g.*, redness, blueness, warmth, and cold, are highly abstract affairs isolated by us for our psychological

purposes from the larger matrix of actual conscious experience of which they form a part. But as a matter of fact when our sense organs are stimulated, we are commonly conscious of *objects* rather than of mere *qualities.* The consciousness of objects, or 'thinghood' is technically called perception and will be studied in the next chapter.

James has hit off the point, in one of his happy inspirations, saying that sensation gives us mere "acquaintance with objects," whereas perception gives us "knowledge about" them. As a matter of fact, it is clear that our sensory experiences which involve simply becoming acquainted with objects are few and far between. The all but universal reaction is one in which we place, or classify, or recognise, the stimulus in some way, thus relating it vitally to our past knowledge. A literally *pure* sensation would only be possible as a first experience prior to all other experience. On the other hand any sensation may be regarded as *elementary* which cannot be further analysed. It should be added, too, that the assignment of objective character to our sense experiences is especially prompt and convincing in those senses which most definitely contribute to our awareness of extension, *resistance,* and *externality* to the organism, *i. e.,* touch and vision.

Despite their abstract and unreal character when taken in isolation, sensations furnish us the basic material upon which our world of knowledge rests. We clothe them with meaning and with associations of innumerable sorts, and in the perceptual and ideational forms, which we shall encounter in our further study, we employ them as the foundation for all our thinking.

From both the psychological and physiological sides therefore, sensory processes are fundamental.

CHAPTER VI

PERCEPTION

Perception, Sensation and Ideation.—Perception has sometimes been defined as "a consciousness of particular material things present to sense." Perception is as a matter of fact always a larger thing than this definition would immediately imply; because we are always aware in the "fringe," in the background of consciousness, of sense activities other than those we speak of as being perceived, especially those connected with the internal operations of our own organism. Perception as psychologists describe it, is therefore, like sensation, something of an abstraction.*

Our definition, however, marks off perception from sensation in its emphasis upon the consciousness of *objects,* or things. Sensation, as we saw in the last chapter, is more appropriately conceived as concerned with the consciousness of qualities. The two processes have this in common, that both are produced by the stimulation of a sense organ. This circumstance serves to mark both of them off from such mental conditions as memory and imagination, in which our consciousness may equally well be engaged with objects. They are probably more apt to lead to immediate motor reactions than these latter ideational processes. Nevertheless, it seems

* It will be seen from this definition that the psychologist uses the term *perception* in a somewhat narrower sense than that recognised in ordinary usage. We speak in common parlance of perceiving the meaning of a theory, when we refer to our appreciation, or apprehension, of it. In such cases we may be engaged in reflection upon the theory, and our thought may thus be quite independent of any immediate stimulation of sense organs.

possible, as we shall see more fully in later chapters, that the sensuous material of perception and imagination and memory is qualitatively one and the same. Visual mental stuff, for example, whether perceptually or ideationally produced, is *sui generis,* and totally unlike any other kind of mental stuff, such as auditory or olfactory.

It will be seen that the radical distinction above mentioned between the perceptual consciousness of objects and such consciousness of them as we may have in memory and imagination rests upon a physiological basis, *i. e.,* the presence or absence of sense organ activity. The only difference on the *mental* side is commonly to be found in the intensity and objectivity of the two. Perceptions are ordinarily more intense, and feel more as though *given* to us, than do our memories or imaginings. Nevertheless, there are many persons whose imagery frequently takes on an almost perceptual vividness and is followed by motor consequences such as normally belong to sense stimuli. The thought of blood, for example, or the description of a wound will in these cases elicit the most life-like visual images followed by nausea and even vomiting. In hallucination, too, it seems as though mere mental images assumed the vividness and externality of percepts; and in the case of very faint stimulations, *e. g.,* of sound or colour, we cannot always be confident whether we have really perceived something, or merely imagined it. This principle of distinguishing the two is, therefore, not always to be depended upon. Fortunately for our practical interests, the distinction is generally valid and we do not often confuse what we really perceive, with what we imagine.

It must be said that certain distinguished psychologists maintain that there is a real difference in quality between perceptual and ideational material. They base their view partly upon introspective grounds and partly upon alleged evidence from cases of mental disease, where the power to obtain images is lost without entire loss of perceptual capacity. To the author the evidence does not appear wholly conclusive for either alternative and he provisionally chooses the simpler. It may well be that the quality of the total psychical conditions is different when one is experiencing a visual percept and a visual image. The difference may well be due to changed organic conditions of some sort. But it by no means follows that the *visual qualities* as such differ in the two cases, otherwise than intensively.

We pointed out the fact in the last chapter that, save for the earliest experiences of infancy, sensation, as a concrete mental state distinguishable from perception, probably does not occur. The great masses of our sensory experiences are, accordingly, perceptions, and it obviously behooves us to examine them with care.

Analysis of Perception: A. Its Unifying Character.—We may evidently have perceptions which originate from the stimulation of any sense organ, and we might select an example from any sense department for analysis. Because of their importance for everyday life we may, however, profitably choose a case from visual perceptions for our examination. Let us take the instance of our perception of a chair. When our eyes fall upon such an object we instantly react to it as a *single* object. The reaction itself is a unifying act. Although the chair has four legs and a seat, we do not see each of the legs as separate things, and then somehow put them together with the seat, and so *mentally manufacture* a chair for ourselves. On the contrary, our immediate response is the consciousness of a single object. We know of course that the chair possesses these various parts, just as we know that it has various colours, and in a sense we notice these features when we perceive it. But the striking thing is, that despite the great number of sensory nerves which are being stimulated by such an object, we perceive it, not as an aggregate of qualities $a+b+c$, but as a *unit,* a whole, which we can, if necessary, analyse into its parts. There is on our part a certain unity of interest in the thing which binds its members into a single whole. The same thing is true as to our perception of words. We naturally see them, not as so many separate letters, but as wholes; or at most as groups of syllables; a fact which modern education wisely takes advantage of in teaching children to recognise *entire words* at a glance.

Evidently this is another phase of the fact which we noted at the time we were studying attention, when we remarked the selective and synthesising nature of the mind in its operation upon sensory stimuli. We also came across the same fact in our description of the action of the cortex of the cerebrum. We observed there, that the cortex has its activity determined, now from this sensory source, and now from that, but the response is always of a unifying, synthesising character. This seems to be the reason, too, that our perceptions are so regularly definite, instead of vague, as they apparently might be. The cortical reaction tends toward the systematised orderly form. We note first, then, in our analysis of visual perception, that we commonly perceive objects as single and distinct, not as vague, confused, and aggregated compounds.

B. Part Played by Experience in Perception.—If we describe for ourselves just what we perceive in such a case, we should add to our consciousness of the colour of the chair our sense of its size and its shape. We say, for example, that the seat is square, that it looks square. Now it requires only a moment's reflection to convince us that, as we stand at a little distance from the chair, the image of its seat, which is reflected upon the retina, is not square at all, but is a kind of rhomboid, with two acute and two obtuse angles. We become more clearly aware of this fact when we attempt to draw the chair as it appears. We are obliged under these conditions to draw just such a rhomboid as the seat presents to the eye. If we draw a *real* square on the paper we cannot make it serve acceptably for a chair seat, seen as we now see the chair of our illustration, which is supposed to be at a little distance from us.

Now, how does it come about that we can perceive a rhomboid as a square, which is what we unquestionably do in this case? The reply contains the secret of the fundamental fact about all perceptions. We see it as a square, because we see it, not as it actually is to our vision at this moment, but as our past experience has taught us it must be. Were it not for the influence of this past experience, this *habitual* reaction upon objects like the present chair seat, undoubtedly we should not see it as a square. The same thing is true as regards our perception of the height and size of the chair, and the material of its construction. Had we no previous experiences that resembled the present one, we should be hopelessly uncertain as to the element of size. To judge of this with any accuracy we must, to mention only a single circumstance, know with considerable exactness the distance of the chair from us; for the nearer an object is, the larger our visual image of it. Experience has taught us the common size of chairs and tables, and has taught us to allow correctly for the effects of distance, etc. We come at once, then, upon this striking fact, that in some manner or other perception involves a rudimentary *reproductive* process. Somehow, our former perceptions are taken up and incorporated into our present perceptions, modifying them and moulding them into accord with the past.

Moreover, if we interrogate our consciousness carefully, we shall find that in visual perceptions we often, perhaps generally, get an immediate impression of the contact values of the seen object. We get instantly something of the cool-smooth-feeling when we look upon highly polished marble. Velvet seen near at hand gives us similarly a feeling of softness. It is not simply that we know the marble to be cool and smooth, or the velvet to be soft. That would be merely a matter of associating certain ideas with the percept. We mean to designate a phase of the actual perceptual synthesis. Individuals vary greatly as regards the manner and the degree in which these secondary sensory implications are experienced. Certain bizarre forms of a similar process, known as synæsthesia, illustrate the point in an extreme way. For example, certain persons when they hear music always experience colour sensations accompanying it. We may regard it as certain, therefore, that sensory stimuli affecting only *one* sense organ *may* set up perceptual reactions involving directly more than one sensory area in the cortex, so that the percept resulting may be regarded as a coalescence of several different sense qualities.

Auditory perceptions show just the same influence of experience as do the visual perceptions which we have analysed. When we first hear a foreign language spoken, it is a mere babel of sounds. Presently, as we come to learn the language, the sounds become words with meanings intelligible to us, and our perception of what we hear thus manifests, as in the case of vision, unmistakable dependence upon our past experience. So also with touch. We learn that certain kinds of contact experiences mean door-knobs, or pencils, or books, etc. We might run through the whole list of sense processes and find the same thing true in varying degree.

We may conclude then, that a second important factor in perceptual processes, in addition to the tendency to perceive objects as definite wholes, is the striking combination of the present with the past, of novelty with familiarity. Were it not for the fact that the perceived object connects itself in some way with our foregoing experience, it would be entirely meaningless and strange to us. This is the way the words of an unknown language impress us when we hear them. On the other hand, the perceived thing is in some particulars different from these previous experiences, otherwise we could not distinguish the past from the present. Perception is, then, evidently a synthetic experience, and the combination of the new and the old is the essential part of the synthesis. This process of combining the new and the old is often called *apperception.* In perception, therefore, the raw material supplied by the several senses is taken up into the psychophysical organism, and there, under the process of apperception, given form and meaning by its vital and significant union with the old psychophysical activities. Material taken up in this way becomes as truly a part of the organism as does the food which enters the alimentary tract.

Genesis of Perception.—It is evident from the facts we have examined in the immediately preceding paragraphs, that the development of perception depends upon the degree to which our past experience enters into the results of each new sensory excitation. In the discussion of habit and of attention, we observed that the mind undoubtedly does make itself felt, first in *splitting up* the undifferentiated, vague continuum of consciousness into parts; then in connecting these parts with one another; and finally in endowing the organism with habits whereby it may the more promptly and efficiently cope with the conditions it has to meet. Clearly, a fully developed perception is itself simply a kind of habit. That I should be able, when looking at a plane surface limited by four lines making two acute and two obtuse angles, to *see* a square table-top is only explicable by remarking that this perception has been acquired just as most other habits have been, *i. e.,* slowly and by dint of many repetitions.

So far as we can determine, experience begins to operate upon our sensory excitations at the very outset of life, and the process of perception accordingly begins, but in a very rudimentary manner, immediately after the hypothetical "first moment" of sensation to which we referred in the previous chapter. Nevertheless, we must suppose that for many weeks the perceptual process is on a very low level of advancement. In the first place, as we pointed out, a perception involves our having some knowledge, however simple, *about* the object.

But such knowledge about objects depends upon our ability to connect *various* sensory experiences with the *same* object, and this in turn depends largely upon our ability to control our movements. We mentioned in an earlier chapter that such control is a relatively late acquirement, and accordingly our perceptual processes get no available opportunity for development in early infancy. An illustration will make this clearer.

Let us take the possible course of events involved in a baby's acquiring the perception of a bell. Obviously the visual factors involved cannot be satisfactorily employed, until some control has been attained over the eye muscles, so that the child's eyes are able to converge and follow an object. This attainment is commonly achieved about the third or fourth week of life, although there is great variation here. If the child never touched the bell and never heard it, he might still learn to recognise it when he saw it, as something he had seen before; but he evidently would have no such perception of it as you and I have. As a matter of fact, the bell will be put into his hand, and during the random movements of the hand his eye will sometimes fall upon it. The occasional repetition of this experience will soon serve to fix the association of the touch-hand-movement feelings with the visual consciousness of the bell, so that the thing seen will inevitably suggest the thing felt and moved, and *vice versa.* Moreover, all the time this has been going on there have been sensory stimulations of sound from the bell. This group of elements, therefore, becomes annexed to the rest of the group, and straightway we have the rudiments of the process by which, when we see or touch or hear a certain kind of object, we promptly perceive it as a bell, *i. e.,* as a something to which a certain total mass of familiar experience belongs.

Such a case as this is typical, and despite certain omissions of detail, may serve to represent the kind of activities which always accompany the acquiring of perception. Obviously the perceptual process involves the establishment of *relations*. In the case which we have used for our illustration these relations show clearly in the connecting of one group of sensory experiences with another. The auditory group comes to *mean* the eye group, and both of these come to mean the hand-movement group. Moreover, the definite establishment of these relations is practically dependent upon the motor factors by which the hand and eye come to control the object. When such relations as these are once set up, we have a definite perception of an object *about* which we know something, *i. e.,* that it is an object from which we can get certain kinds of familiar experiences.

It will be seen at once that in this series of events by which the perception becomes definite, the several steps involved are brought about on the strictly mental side by the activities involved in attention, which we have previously sketched. First, there is the dissociative process, throwing out into the foreground of consciousness the visual characteristics of the bell, as distinguished from other things in the visual field. This is followed by the associative, or relating process, which connects this visual bell with the auditory and tactual-motor experiences. It remains, then, to inquire what further development takes place after the accomplishment of this synthesis of the different sensory activities of sound, sight, and touch into the consciousness of a single object.

Perception and Habit.—We spoke of fully developed perceptions a moment ago as habits. If this metaphor were entirely appropriate, it might seem that perceptions would come to a certain point of development and then stop. Clearly, our reference to habit was in one particular misleading. Our most perfect habits are all but unconscious. A perception, on the other hand, is distinctly a *conscious* process. The truth of our statement lies in this fact, *i. e.,* that we tend to become unconscious of objects and to react to them in accordance with the principle of mere habit, just in the degree in which our necessities permit us to perceive and react upon them in *literally* the same manner, time after time. We thus become almost wholly oblivious to the exact appearance of a door-knob which we have occasion to turn very often. Our eyes may rest upon it momentarily, but only long enough to guide the hand in its movement, and often without registering any visual impression of which we could immediately afterward give an exact account. There are also certain features of the neural process in perception which warrant our comparison with habit, and to these we shall come in a moment. The great mass of our perceptions, however, are of objects whose relations to us change sufficiently from time to time to make any complete subsidence of our consciousness of them incompatible with their effective manipulation; consequently we continue to be definitely aware of them.

Development of Perceptual Process.—The development of perception, which goes on in a certain sense more or less all our lives, and in a very definite sense up to the period of mental maturity, is plainly not a development involving simply a more automatic response to objects. Quite the contrary. The process which we commonly think of as growth in the powers of perception consists in the further elaboration of our discriminative and associative activities. We learn to see new things in the old objects, new characteristics, which before escaped our knowledge. We also learn more about the objects, and thus, when we perceive them, perceive them in a modified and more intelligent way. Speaking literally, it therefore appears that development in perception really involves perceiving *new objects* in the old.

A moment's reflection will show the similarity of this fact to one which we noted when analysing attention, *i. e.*, that to continue our attention to an object for more than a moment, we must notice something new about it, see it in a new way. We might of course substitute the word perception for the word attention, inasmuch as attention is an attribute of all consciousness, and then the proposition would read: we cannot continue to *perceive an object* beyond a moment or two, unless we perceive it in a new manner. Perceptions which we do not execute in a new way, we have already seen do actually tend to lapse from consciousness, passing over into habits of response which we make to certain physical stimuli.

When a child is taught to observe the arrangement of the petals of a flower, he henceforth perceives the flower in a new way. To him it really is a new object. All development in perception is of this kind, and constitutes a sort of transformation by the unfolding of the old object into the new and richer one. The larger part of this perceptual development occurs during childhood and adolescence. Nevertheless, there is a continuation of the process in an inconspicuous way far into old age. Thus, we come in childhood to recognise the salient characteristics of the common things about us in every-day life. During adolescence we enrich this material by observing more accurately the details of these things, and by increasing our knowledge of their general purport and relations. After attaining maturity our further advance is almost wholly connected with the affairs of our professional, or business, life. The musician becomes more sensitive to the niceties of harmonic accord and the nuances of melodic sequence. The business man becomes more observant of the things which pass under his eye, so far as they are related to his specialty. The elementary school teacher learns how to keep the corner of her eye sensitive to iniquity upon the back seat while apparently absorbed in listening to the recitation of virtue upon the front bench. The mother learns to watch her children with an increasingly intelligent discrimination between acts which indicate illness and those which indicate fatigue, excitement, and transitory irritation. Everywhere development is primarily shown by fresh skill in the detection of new features in old things.

Illusions.—Certain instances of illusion furnish a striking confirmation of the general idea of perception which we have been explaining. An illusion is a false, or erroneous, perception, which is often spoken of as a deception of the senses. But this is often misleading, as we shall presently see, for the senses frequently operate properly enough. The difficulty is with our reaction upon the sensory material furnished to us. Indeed, there is undoubtedly a measure of illusion in most perception, but unless it is sufficiently significant to cause practical difficulty, we entirely overlook it.

Among the most frequent of such illusions is the misreading of printed words. We sometimes read the words put before us as we have reason to suppose they ought to be, not as they are. Thus, if we come across the word mispirnt, many of us will read it in all good faith as misprint and never see the difference. We react to the general visual impression and its suggestion, and we see what really is not before us. If the sentence in which the word occurs is such as to give us a definite anticipation of the word, the probability of our overlooking the typographical error is much increased. Similarly when we come into a darkened room where sits a spectral form—an experience which as children most of us have had—we see a person with startling clearness; and the subsequent discovery, that the supposed person consists of clothing hanging upon a chair, is hard to accept as true. Illusions of sound are very common. We fancy we hear our names called, when in point of fact the sound we thus interpret may have been anything from a summons to some other person of similar name, to the barking of a dog, or the whistle of a locomotive. Tactual illusions are also easy to produce. The so-called "illusion of Aristotle" is a good specimen. (Figure 51.) Children often achieve it by crossing the first and second fingers, and then moving to and fro upon the bridge of the nose with the crotch thus formed between the fingers. Presently one becomes distressingly impressed with the fact that one possesses two noses.

The Causes of Illusions: A. Central Interpretative Factors. —This last instance is typical of many illusions, in that it is caused by stimulating with a single object the sides of the two fingers which are not ordinarily in contact with one another, and for the stimulation of which, accordingly, two objects are commonly necessary. We react in the familiar, the *habitual*, way to the simultaneous stimulation of these areas of the skin. This has invariably been accomplished hitherto by the pressure of two objects, and two objects we therefore feel. It is clear that in such a case the sense organ is in no way at fault. It sends in the impulses communicated to it just as it has always done before; but the reaction which we make upon the impression also follows the usual course, and in this special case happens consequently to be wrong. The same explanation applies to our reading of incorrectly spelled words. Many illusions of movement, *e. g.*, such as we obtain in railroad trains, are of this character.

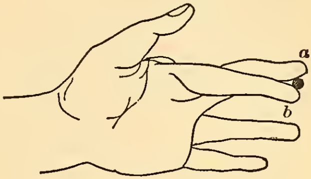

Fig. 51.

The same general principle holds, but applied in a slightly different manner, when we see, or hear, or otherwise perceive, some object not actually present, because we are *expecting* to perceive it. Thus, if we are listening for expected footsteps, we find ourselves time after time interpreting other sounds as those of the awaited step. At night the nervous housewife wakens to hear the burglars passing from room to room along the corridor. Step follows step in stealthy but unmistakable rhythm, though the whole impression has no other objective basis than the occasional cracking of floors and partitions, phenomena which are the constant accompaniments of changing temperature. Illusions of this sort are readily induced if we have *recently* had experiences which might suggest them. *Recency* of *similar experience* has, then, to be added to *expectancy* and *habit* as a possible source of illusory perception.

It is clear that a consideration of certain types of illusion affords new and striking confirmation of the part played in perception by previous experience. The cortical reaction suggested by the stimulus does not happen to correspond to the object actually present. But this cortical reaction is evidently determined by the impress of old perceptual experiences whose traces have been preserved.

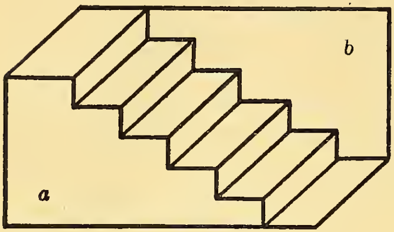

FIG. 52.

The same point is admirably illustrated by such drawings as the accompanying, figures 52 and 53. We can see the stairs, either as they appear from above, or from below. In one case the surface *a* seems nearer to us; in the other case *b* seems nearer. We can see in the other figure a big picture frame, the frustrum of a pyramid, or the entrance to a square tunnel. Yet one and the same object is presented to the retina in each case. The eye can hardly be accused of entire responsibility for the shifting results. But lines like these have actually been connected in our former perceptions with the several objects named, and in consequence the cortical reaction appropriate to either of them *may* be called out. It would seem abundantly certain, therefore, that *while a portion of what we perceive is always supplied from without, another portion, and often the dominant portion, is supplied from within ourselves.*

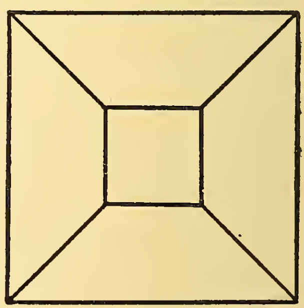

FIG. 53.

B. Peripheral Factors.—There are many kinds of illusions, be it said, which do not come immediately under the headings we have discussed. For example, such illusions as that in figure 54 are much too complex in their basis to be properly included, without modification, under the explanatory rubrics we have considered. The innervation of the eye muscles is probably an influential element in many illusions of this character. In the upper figure the short angular lines carry the eye in large sweeping movements out beyond the main line, whereas in the lower figure these movements

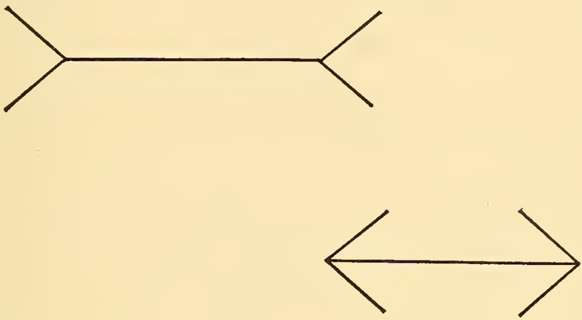

FIG. 54. Despite their contrary appearance, the two horizontal lines will be found of equal length.

tend to be checked by the recurrent angular lines. Even though the eye does not make a very different excursion in the two cases, we notice a distinct difference in the seeming magnitude of the movements and this difference is naturally transferred to our judgment as to the extent of the lines. In certain forms of this type we sometimes find that there is a suggestion of an enclosed figure, which in the case of the lower of these particular figures is evidently smaller in its horizontal dimensions than that of the upper figure. Photographs have been made of the eye while observing illusory figures of many sorts and from these it is perfectly obvious that while the eye seldom follows precisely any of the lines of a figure, nevertheless the movements which are actually executed vary greatly in dependence upon the position of the various lines which make up the figure in its entirety. Where these movements involved in perceiving are very different, it is to be expected that our judgments of the space relations of the objects perceived should also vary.

Probably the actual conformation and the muscular mechanism of the sense organs, especially the eye, may be immediate causes of a number of illusions. The tendency to see a vertical line as longer than a horizontal line of equal length has been regarded as an instance of this sort, because more muscles are involved in vertical movements and therefore presumably more complex innervation is required. We judge that line longer which requires the greater effort to traverse. To make clear other cases of this kind would require more space than can properly be given here. Certain it is, however, that we perceive all objects in ways which vary with their surroundings. We noticed in the chapter on sensation that colours are seen very differently when combined with differing companions. Red seen beside yellow looks quite different from red seen beside blue. A sound seems much louder if heard in the midst of quiet than if heard amid louder sounds. Large objects are made to appear larger by contrast with very small ones. In short we perceive all things in relations which modify them and many of these modifying circumstances are primarily conditions in the sense stimuli.

Hallucination.—In distinction from illusion, which is essentially perception, (*i. e.,* a consciousness of particular material things present to sense—though other things than those really perceived happen to be present), hallucination is the name given to the consciousness of objects felt to be physically present, when as a matter of fact no object of any kind is at hand. Illusions are every-day experiences familiar to all of us. Hallucinations, while by no means infrequent, are much less common and consequently more difficult to describe satisfactorily. Many of the alleged telepathic phenomena involve hallucinations. Thus, for instance, one is sitting alone in a room and suddenly sees another person, known to be thousands of miles distant, come in and sit down. Again, when alone in the same way, one suddenly hears some sentence clearly spoken. In neither case, needless to say, is anyone actually present, save the owner of the hallucination; and there are no obvious external phenomena which could be held accountable for the experience. All the senses seem to be represented from time to time in the hallucinatory perceptions, although hearing and vision are, perhaps, the ones most frequently involved.

An interesting distinction has been made between true hallucination and what is called pseudo-hallucination. In the first case the perceived object not only seems external and real, but there is in the mind of the person experiencing the hallucination no suspicion at the time that the object seen, or heard, is not actually real and present. In the second form there is a sort of background consciousness, such as we sometimes note in dreams, which assures the victim that the phenomenon is after all imaginary and unreal, despite its genuinely objective appearance.

It has been suggested that hallucinations are really extreme forms of illusions, extreme cases of misinterpretation of sensory stimuli, resting upon highly disintegrated cortical forms of reaction. The sensory source of the stimulation has been sought at times in pathological conditions of the sense organs, *e. g.*, congestion of circulation in the eye, or ear, etc.

There are many facts which tend to confirm this view, which is advocated by certain of the most competent judges; and some others which are very difficult of reconciliation with it. A discussion of the point at issue would take us too far afield for present purposes, and readers who are interested in such matters must consult some of the more extended and specialised treatises. Meantime, we must admit that unless this last suggestion is correct, hallucination furnishes an exception to the general rule that cortically initiated conscious processes are less vivid and less definitely externalised than those which originate in sense organs. If hallucination is not peripherally initiated, it belongs to the group of phenomena which we shall examine in the chapter upon imagination, and we may defer further discussion of it until we reach that point.

Neural Process in Perception.—The nervous pathways involved in perception have already been described in a general way in chapter II. In vision, for example, the occipital regions in the cortex are unquestionably employed, in cases of auditory perception the temporal region is active, etc. Undoubtedly the association areas also play a very important part. Connected with their activity there is this highly important fact to be taken more explicitly into account, *i. e.,* that in perception the cortical activity, which is in part decided by the *kind* of neural stimulus sent into it, is in large measure determined by the *modifications* which *previous experiences* have impressed upon the structure of the hemispheres. Evidently this is but a statement in physiological terms of the doctrine which we have already enunciated in psychological form. As we observed in our discussion of habit, every nervous current which passes through the central system seems to leave its impress behind it, and this impress modifies the nature of the neural excitations which follow it. The case of perception is, accordingly, only a special instance of this general principle, albeit a peculiarly important and conspicuous one. It is on this account, *i. e.,* because of the fundamental importance of the accumulating modifications of the cortex, that we compared perception, earlier in the chapter, to the case of habit. From the side of neural action, therefore, perception cannot be referred simply to the employment of a certain pathway throughout the sensory-motor tracts; it must be referred to a certain *kind* of action, in which the result in consciousness appears to be a product of two neural factors—sensory stimulus into cortex modified by previous experience.

General Function of Perception: A. Its Organic Relations.—In order to give perceptual processes their proper setting among the psychophysical activities of adjustment, we must revert once again to our notion of the sensory-motor circuit. We have already observed that in this device the sense organs represent so many telephonic receivers ready to transmit inward messages from the external world to the organism. We have also described in a general way the method by which certain kinds of motor reactions to these sensory stimulations are brought to pass. But in the higher brain centres the pathways connecting sense organs with muscles are often extremely complex, and a stimulus transmitted inward by the afferent nerves may lead to innumerable intermediary brain activities before it issues again in movements of the voluntary muscles. Now perception is the conscious concomitant of certain of these brain processes. Memory, imagination, reasoning, etc., are others. Bearing these facts in mind, and observing closely what actually occurs when we are engaged in perceiving objects, we readily detect the main functions of perception.

B. Perception as an Elementary Form of Knowledge.—Perception represents the immediate, organised, mental reaction of the individual upon his environment. The process is sometimes called presentation, and this is a good name for it. In it the world is presented as a system of relations—not merely reflected as a disorganised mass of atoms and molecules, but constructed by the various activities of attention into definite objects. If sensation is properly described, after a common fashion, as the process in which the mind and the world of matter first come together, perception may be described as the point in which the past and the present come together for the creation of a new object. The perceived thing is not simply the physically present vibrations of atoms and molecules which we call light, or sound, or what not; it is these vibrations, as they are *interpreted* by a psychophysical organism which exposes to them a nervous system already affected by past experiences, that enable it to get only certain specific kinds of results from the present synthesis. Evidently we make far more constant use of our past experience than common-sense observation would lead us to suppose. It is not only when we reflect upon our past life that we shape our action in accordance with its instructions and admonitions; every time we open our eyes to see, or our ears to hear, what *we can* see and hear is in a true sense and in a large measure determined for us by what we have *previously learned* to see and hear. It is a moralistic truism that only the good can really love and appreciate virtue. But this principle is not simply, nor primarily, a moral tenet. It is based on irrefutable and unavoidable psychological foundations. It states a law of the mind which we might wish at times to change, but cannot. The first and basic function of perception, then, is to afford us our primary knowledge of a world of objects amid which we have to live. It is the first actual, definite, and complete step in the process of knowledge whose further and more complex features we have next to examine.

C. Perceptual Control over Movements.—The second great function of perception grows out of the first. Indeed, it might be regarded as in a measure simply a corrolary of the first. All the sensory and afferent processes have their ultimate value, as we saw must be the case in chapter II., because of the more efficient movements of adjustment to which they lead. Perception is no exception to this rule. Now in order that sensory stimulations may not lead *at once* to motor responses, but may be interpreted and correlated with other sensory impulses, it is evidently necessary that there should be some provision for halting them momentarily, and identifying them, when they come again and again. Perception is the process by which this identification is made possible; and so it comes to pass that perception is the first, both logically and genetically, of the conscious operations by which the life of control is inaugurated.

We have repeatedly seen that perception involves immediately within itself the effects of antecedent experience, and a secondary result of this complication with memory processes is that when we perceive an object which is in any way familiar we instantly *recognise* it. If the object thus recognised be one about which our previous experience is unambiguous, we respond almost instantly with appropriate movements—those of aversion, if it be repulsive or harmful, those of approbation, when the contrary sentiments are aroused. If the object have no such definite antecedent reactions (whether native or acquired) connected with it, we straightway fall to deliberating as to our course of action; or if the impression be wholly fleeting, we pass to some more stimulating excitement.

Perception is thus the gateway through which the mass of sensory excitations (save those already grown purely habitual) must pass before they can be permitted to set up motor responses of the volitional kind. Often the perceptual activity is sufficient to decide this volition. The clock strikes and we rise to leave the room. When mere perception is not felt to be adequate to the case, the matter is handed over to reflective deliberation. In either event, voluntary response is safeguarded. *The formation of the elements of the process of knowledge and the inauguration of the control over movements in accordance with the mandates of experience—these are the two great functions of perception.* This statement applies without modification to the special phases of perception, to which we shall next advert.

CHAPTER VII

PERCEPTION OF SPATIAL AND TEMPORAL RELATIONS

I. SPACE

The objects which we have mentioned in our analysis of sensory consciousness are all objects perceived by us as parts of a spatial and temporal order; and it is evident that our account of them would be extremely defective if we altogether omitted a study of these time and space relations. We shall consider space first.

Two Fundamental Problems.—Psychologists are divided in opinion upon two fundamental problems concerning our space perceptions. It is maintained in the first place by some of them, the nativists, that the capacity to perceive space is an innate, hereditary trait possessed by us in advance of experience. Others, the empiricists, maintain that spatial judgments are as much the results of experience, are as truly acquired, as piano playing or the liking for caviar. We shall not discuss the question, for this would require more time than we can give it. But we may register the dogmatic opinion that both parties to the controversy are in a measure correct. We hold that the crude, vague consciousness of extension, of volume, is a genuinely innate experience, occurring at once upon the reception of appropriate sensory stimulation; and that it is underived by mere experience from non-spatial psychical elements. So far we are nativists. On the other hand, we are confident that practically all accurate knowledge of the meaning of the space *relations* in our space world, all precise perception of direction, position, contour, size, etc., is a result of motor experience, and could never be gained without it. So far we are empiricists, holding to a genetic point of view regarding the development of our adult space consciousness. Effective space perception involves not only the experience of vague extension, but also movements of localisation. In the human being there are surely but few localising movements which are wholly innate. The analyses and discussions which follow will serve to furnish some of the evidence upon which this view rests.

Sensory Basis of Spatial Perception.—The second main point upon which psychologists are unable to agree concerns the sensory sources from which we gain our spatial judgments, a matter to which we made cursory reference in chapter V. The majority of psychologists maintain that vision and touch are the only real avenues of spatial perception; whereas certain others, like James, boldly maintain that all forms of sensory consciousness are "voluminous,"—smell and taste and audition, as well as sight and touch. The doctrine maintained in this book is that all forms of sensations are immediately *suggestive* of spatial attributes, *e. g.,* position, size, distance, etc.; but that only sight and touch possess intrinsically and completely the full spatial characteristics. We include in touch, when thus mentioned, all the cutaneous sensations and the motor, or kinæsthetic, sensations. As a matter of fact, however, the temperature and pain sensations, considered apart from pressure and sensations of movement, are ordinarily negligible elements. When involved in conjunction with pressure, they often modify our perceptions materially. Thus a cold object, *e. g.,* a coin laid on the forehead, often feels larger than a coin of equal size, but of the body temperature.

Doubtful Cases.—Taste and smell and hearing are really the debatable sensations. Taste we throw out of court at once, because taste stimuli practically involve invariably the stimulation of cutaneous sensations of contact and temperature. We cannot, therefore, submit the matter to unambiguous introspective analysis. Smells we undoubtedly classify at times in ways suggesting spatial attributes, and by turning the head until we determine the direction of maximum intensity we undoubtedly localise them roughly. The smell of illuminating gas seems somehow a more massive, extensive sort of thing than the odour of lemon peel. But if one lessens the disparity in the *intensity* of the two odours, by getting just the merest whiff of the gas and inhaling freely and deeply of the lemon odour, the spatial difference between the two begins to evaporate. There can be no question but that we tend to think of the more intense and more widely diffused odour as the larger. Nor is this remarkable, since we find it actually occupying more of the atmospheric space about us. But when we note that with mild intensities of odours their spatial suggestiveness wanes; when we further note that we have no definite impressions of size, much less of shape, under any conditions; and finally when we remark that even our ability to localise odours is extremely imperfect, we may well question whether smell has itself any properly space quality.

The case of auditory space is similar to that of smell. We are told, for instance, that the tones of the lowest organ pipes are far larger, far more voluminous, than those of the high shrill pipes. A base drum sounds bigger than a penny-whistle, a lion's roar than the squeaking of a mouse, etc. Such illustrations, when adduced as evidence of the spatial character of sounds, evidently contain three possible sources of error. In the first place, we often *know* something about the causes of these sounds, and we tend to transfer the known size of the producing object to the supposed size of the sound. Secondly, and of far more consequence, sounds affect other organs than those of the internal ear, especially when they are loud or of deep pitch. Powerful tones thus jar the whole body, and are felt all over. Moreover, vibrations of the drum membrane of the middle-ear undoubtedly set up crude sensations of pressure, or strain, to which we may come to attach a spatial significance associated with the sound. Add to this, thirdly, the fact that we readily convert judgments based upon the intensity of sounds into judgments about their extensity, just as in the case of smell, and one has a large mass of considerations leading to scepticism concerning the genuineness of intrinsic auditory space relations. Of course, no one doubts that we localise sounds, and of the factors involved in this process we shall have more to say presently. But the fact that certain sounds are located within the head (*e. g.*, when two telephone receivers are placed against the ears and an induction shock sent through them) has been cited to prove the native possession of a true auditory space; for here apparently experience from the other senses, such as vision, would give no direct assistance. But these cases are certainly capable of explanation by means of the intra-cranial sensations set up in pressure nerves by bone vibrations, and by the effect of the imagination, visual and otherwise. Taken alone, such evidence could hardly be conclusive.

If we come back, then, to ordinary introspection, we find that all which the most ardent partisans of an auditory space can claim is a much emaciated form of the visual and tactual article. A vague sense of volume, or mass, much vaguer even than that given by mere temperature, with some crude sense of position, would seem to be the utmost capacity. Any sense of contour or shape or exact size, any ability to measure, is lacking. Clearly such a space, even if genuine, which we doubt, would ill deserve to be ranked beside the space of sight and touch. The manner in which we *localise* sound may best be described after we have analysed visual and tactual space.

Growth of Space Perception.—Our adult cognition of space relations is generally so immediate and unreflective, the feeling for space values so compelling and seemingly inevitable, that we find it difficult to believe that these reactions are the results of a slow process of growth and learning. Nevertheless, this is unquestionably the fact. Babies evidently have no precise perceptions of space until they have acquired a considerable degree of motor control; and even then their appreciation of large expanses and distances is often ludicrously inexact. The child reaching in good faith for the moon is the stock illustration of this sort of thing. That we have no precise appreciation of visual space relations until experience has brought it to us is abundantly proven by the cases of persons born blind and successfully operated upon for the restoration of sight. Immediately after the operation such persons are almost wholly at a loss for accurate impressions of size, shape, or distance. After the hands have explored the objects seen, and the eyes have been allowed to pass freely to and fro over them, these spatial impressions gradually begin to emerge and take on definiteness. By the use of properly arranged lenses and prisms experiments of various kinds have been made on normal persons, showing that we can speedily accommodate ourselves to the most unusual inversions and distortions of our visual space. We can thus learn to react properly, although all the objects, as we see them, are upside down and turned about as regards their right and left relations. The new relations soon come to have the natural feeling of ordinary perceptions.

These observations show very strikingly that our space perceptions are functions of experience and can be changed by changing the conditions of the experience. Moreover, it is easy to demonstrate that the space relations, as we perceive them by different senses, are far from homogeneous. Indeed, the impressions which we gain from the same sense are often far from being in agreement. Nevertheless, we feel our space relations to be objectively homogeneous, a result which could hardly come about under such circumstances of sensory disparity without the harmonising effects of experience. To illustrate—the edge of a card pressed gently upon the forearm will feel to the skin shorter than it looks. The same card, if the finger tip is allowed to run slowly along it, will feel longer than it looks. The disappointing disparity between the cavity of a tooth, as it feels to the tongue and appears to the eye or feels to the finger-tip, is a notorious instance of the same thing. The tongue and the finger-tip both give us *pressure* sensations. Yet they give a very different report of the same object. Similarly, objects seen upon the periphery of the retina appear smaller than when seen by the fovea; and often they undergo a certain distortion in form. That we should perceive, amid all these possible sources of confusion, a fairly stable and well-ordered space world betokens unmistakably the systematising effects of experience, controlled no doubt by the exigencies of our practical interests in effective orientation.

Part Played by Movement.—Even though we recognize the fact that experience brings order and precision and effectiveness into our space perceptions, the general manner by which these results are achieved is not yet clear; much less what factors are chiefly employed in their attainment. It requires only the most cursory examination to convince oneself that the all-important element in the building up and correlating with one another of our various spatial sensations is *movement*. In acquiring accurate touch perceptions, for instance, the finger-tips and hands move over the object, grasp it now in this way and now in that, until a complex set of tactual impressions has been gained from it. Without such movement our touch perceptions are vague in the extreme. If we close our eyes and allow another person to put a series of small objects upon our outstretched hands we receive only the most indefinite impressions of form and size and texture. But allow us to manipulate the same objects in our fingers, and we can give a highly accurate account of them. Similarly, if we wish to compare visually the magnitude and contours of two objects, we must allow our eyes to move freely from one to the other. Indeed, reflection must assure us that the *vital meaning* of all space relations is simply a given amount and direction of movement. To pass toward the right means to make a certain kind of movement; to pass upward means to make another kind, etc. To be sure, we assign arbitrary measures to these relations, and we say an object is a *mile* away, or is a *foot* thick and six *inches* high. But the meaning to us of the mile, the foot, and the inch must always remain ultimately expressible in movement.

Were it possible to get at the exact stages in the process by which the child acquires its control over space relations, we should thus secure the most penetrating possible insight into our adult space perceptions. But as this is at present impracticable, we must content ourselves with an analysis of the factors which seem clearly involved in these adult conditions, without regard to their genetic features.

Touch and Vision.—It is certain that touch and vision practically coöperate from the beginning, and we shall isolate them from one another only to point out their respective peculiarities, and not because their operation is independent. The most important, and for practical purposes the most accurate, part of our touch perceptions comes from the hands and finger-tips. By moving the hands over the various parts of the body we come to have a fairly accurate notion of their touch characteristics in terms of the hand as a standard. Moreover, each hand touches the other, and we thus get a kind of check from touch on the tactual standard itself. Generally speaking, when two parts of our body touch each other we *feel* the *one* which is quiet with the one which is moving. Thus, if we stroke the forehead with the fingers we feel the forehead; but if we hold the hand steady and move the head, we feel the fingers. Now in order that we should be able to learn in these ways that a certain amount of sensation in the finger-tips *means* a certain area on the forehead, and, much more, that we should be able to tell with so much accuracy when we are touched what part of the body the sensation comes from, seems to depend upon what Lotze calls the "local sign."

Local Signs.—If one is touched upon the palm and upon the back of the hand, one obtains from both stimulations sensations of pressure; but however much alike they may be as regards duration, intensity, and extensity, we promptly feel a difference in them, which leads us to refer each to its appropriate region. Now this something about touch sensations which permits us to recognise them as locally distinct, although we recognise all of them as being cases of contact, is what is meant by the local sign. These local signs, then, are the relatively *fixed elements* in our space-perceiving processes. It is by learning to correlate one group of them with another group that we can develop by experience the accuracy of our perceptions. Thus, for example, we come to learn that the stimulation of one series of local signs in the order *a-b-c* means a special movement of one hand over the other, say the downward movement of the right hand over the left. The same series stimulated in the order *c-b-a* means the reverse movement. It must be remembered very explicitly at this point that we are including the kinæsthetic sensations of movement under the general heading of touch; since we doubtless have local signs of movement distinct from those of the cutaneous pressure sense, and they doubtless play a very important part here. But they are commonly fused in an inextricable way with the pressure sensations, so that a separate treatment of them seems hardly necessary in a sketch of this kind.

A Caution.—A warning must be held out at this point against the fallacy of supposing that in learning his space world a child uses these local signs in any very reflective way. He does not say to himself: "That movement of localisation was inaccurate because I used the wrong local sign to control it." He generally employs the "try, try again method," until he hits the mark. But his success carries with it a recollection of the total feeling of the successful experience, and in this total feeling the local sign element is an indispensable part, even though the child is not himself definitely cognisant of the fact.

The simultaneous stimulation of a group of these local signs gives us the extensity feeling of touch, and when the impressions come from three-dimensional objects we get, through our motor reactions upon them, experiences of change of motion in three cardinal directions. This seems to be the basis of our tactual tri-dimensionality.

Delicacy of Touch.—In normal persons touch falls far behind vision in its spatial nicety of function, and far behind its possible capacities, as is shown by the astonishing accuracy of blind persons, who do not, however, seem to be notably more accurate than seeing persons as regards the parts of the body which are not used for tactual exploration, *e. g.*, the forearms and the back. But despite its lesser delicacy, touch-movement undoubtedly plays an important rôle during childhood in furnishing interpretative checks upon our visual estimates of large areas and great distances. The visual perception of a mile, for instance, gets a practical meaning for us largely through our walking over the distance. Moreover, although vision so largely displaces touch in our actual spatial judgments, touch always retains a sort of refereeship. When we doubt the accuracy of our visual perceptions we are likely, whenever possible, to refer the case to touch, and the verdict of this sense we commonly accept uncritically.

Peculiarities of Vision.—Vision resembles the non-spatial senses of smell and hearing in one particular which marks it off characteristically from touch. Touch sensations we commonly refer to the surface of the body itself, although when we tap with a cane, or a pencil, we seem to have a curious kind of projection of part of our sensations out to the farther tip of the object. Visual objects we always place outside ourselves. Even our after-images gotten with closed eyes often seem to float in a space vaguely external to ourselves.

It seems necessary to assume a system of local signs for vision, comparable to those of touch-movement, although doubtless more complex. It must be admitted, however, that introspection is much more uncertain in its deliverances here, than in the case of touch, and we shall be on somewhat speculative ground in assuming the nature of this visual local signature. It seems probable that this attribute of sensations from the *periphery* of the retina consists primarily in reflex impulses, or tendencies, to movement toward the fovea, the fovea itself furnishing a peculiar sense quality which serves more or less as a fixed point of reference. Certain it is that stimulation of any part of the retina tends to release movements turning the fovea toward the stimulus. Moving objects are especially effective in producing such movements.

The incessant and complicated movements of the eyes over the visual field must speedily render the relation of the various retinal points as conjoined by movements, intricate in the highest degree. But such relations as exist must pretty clearly rest on the intermediation of movements with their motor and retinal effects upon consciousness; and it seems probable, therefore, that the space value of any retinal point comes to be determined by the position it occupies in such a system of movements. Thus, a point 20° to the right of the fovea in the visual field comes to mean to us a definite kind of motor impulse. One 20° to the left, another kind of impulse, etc. Whether the visual local sign is actually this sort of a fused retinal-kinæsthetic affair or not, there can be no doubt that, as adults, we have a remarkably accurate sense of the general space relations of the objects in the field of view, and that we can turn our eyes with unhesitating accuracy to any part of this field. Moreover, experiments have shown that the behaviour of the eye movements depends upon the condition of the entire visual field. For instance, the eyes are ordinarily more stable in their muscular balance when looking at a field where a considerable complexity of detail is discernible than when the surface is plain. Their movements in dim light are much less well balanced and coördinated than in a bright light.

The Binocular Conditions of Single Vision.—In the chapter on sensation we explained the processes of accommodation and convergence by which the eyes are turned together towards any object we desire to see and the rays of light from it focussed so as to produce a clear image on the retina. Figure 55 illustrates the conditions under which we receive either single or double impressions from any given stimulus. When the foveæ of the two retinæ are stimulated, as in ordinary convergence upon an object, we always see a single object. If two tubes ten inches or thereabouts in length be supplied with thin white paper caps fastened smoothly over the ends, an interesting demonstration of this statement can easily be made. Upon each of the paper caps mark a straight black line corresponding to a diameter. Then hold the tubes parallel to one another in front of the eyes and look into the open ends. This will insure the stimulation of the fovea of each eye by the line across the end of its own tube. If the lines be in a position of parallelism with one another, their images will swim together into a single line. If they be held at an angle to one another, they will appear as a single figure forming a cross of one or another form. If the caps be given very different and complex figures, we shall generally see first one and then the other of the figures, but while the tubes are parallel we never see two separate objects. This last phenomenon is known as retinal rivalry.

Each point on each retina has a point known as its "corresponding point" on the other retina which, if stimulated with it, leads to single vision. The stimulation of non-corresponding points produces double images or blurred vision, as the case may be. The legend under figure 55 will make clear the details.

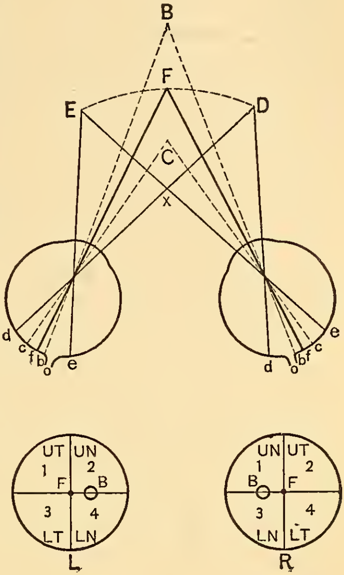

Fig. 55. The two lower circles represent the retinal surfaces of the two eyes as seen from behind. *F* is the fovea, *B*, the blind spot where the optic nerve enters the eye. The retinae are divided into four quadrants. Each quadrant corresponds to its geometrically (*not anatomically*) similar quadrant in the other eye, which bears the same number. The *nasal* half of one retina corresponds to the *temporal* half of the other, Corresponding points whose stimulation produces single vision are located in geometrically similar quadrants. The stimulation of other than corresponding points leads to either blurred or double vision.

The upper part of the diagram represents the eyes fixated on the point *F* whose images fall on the two foveal regions *ff* and produce single vision. O is the optic nerve. Rays of light from such points as *E* and *D* fall on the corresponding points *ee* and *dd* and also produce single vision. Such a line as *EFD*, or it may be a surface, all of whose points are seen as single, is known as a horopter. When the eyes are fixated on *F*, points like *B* and *C*, which lie respectively behind and in front of *F*, are seen double. The rays proceeding from them will be found in non-corresponding quadrants of the retinae at *bb* and *cc*. The rays from *B* fall at *b* and *b* which are both inside the foveal points, whereas *c* and *c* are both outside these points. The former produce 'homonomously,' the latter 'heteronomously' doubled images.

The reality of these double images may easily be verified by holding up pencils in front of the face, one about a foot behind the other, and then fixating first on one and then on the other. The *unfixated* pencil will be seen double. If an assistant pass a screen in front of one of the eyes, the double image on the same side as the screen will disappear when the nearer pencil is fixated. This is the case of the 'homonomous' image. The

The Third Dimension.—Psychologists have always been especially interested in the problem of the visual perception of distance, or the third dimension. Bishop Berkeley maintained in his celebrated work entitled "Essay Toward a New Theory of Vision" (1709), that vision cannot give us any *direct* evidence of distance, because any point in the visual field must affect one point and one only in the retina, and it can affect this no differently when it is two feet away from what it does when four feet away. Therefore, Berkeley concluded that our perception of visual distance is dependent upon our tactual-motor experiences. This view overlooks several important facts, including its plain contradiction of our common conviction about the matter. In the first place, we have two eyes, and each eye sees a part of solid objects varying slightly from that seen by the other, as may easily be proved by looking at some solid object like a lead pencil with first one eye closed and then the other. Compare figure 55. The psychical percept of such objects appears to be a fusion of the factors supplied by the two eyes, and we get from this source the visual sense of solidity. The stereoscope employs this principle, and by giving us pictures which exaggerate somewhat the disparity in the point of view of the right and left eye affords us a most startling impression of distance and volume. If the pictures presented to the two eyes be exactly similar, we see a flat surface instead of a solid. By allowing each eye to see the side of the object ordinarily seen by the other, the pseudoscope renders hollow objects apparently solid and solid objects hollow.

Furthermore, we converge our eyes more upon near points

image in the side opposite to the screen (*i. e.* heteronomous) will disappear when the farther pencil is fixated.

Such a figure as the prism *EXD* illustrates in an extreme form the facts of binocular stereoscopic vision. The right eye sees only the surface *XD*, the left eye only *EX*. The figure as seen by both eyes appears as a solid. Ordinarily there is a field common to both eyes as in looking at a sphere.

than upon far, and the muscular strain thus brought about may serve to inform us of differences in distance. Similarly, the muscles controlling the lenses contract with varying degrees of intensity in the effort properly to focus rays of light from objects at different distances. Monocular vision has therefore a motor index of tri-dimensional properties, but it is extremely imperfect in practical exigencies. How far our consciousness of these focussing movements is significant for our judgments of distance it is difficult to say. But it is at least clear that there are factors operative other than those Berkeley emphasised, and the genuineness of the optical sense of distance can hardly be seriously questioned. The eye is, in short, not merely a *retina,* it is a *binocular motor* organ as well. Normally, therefore, visual perceptions are always fused stereoscopic binocular-motor experiences.

We use in actual practice other forms of criteria for distance. Thus, the apparent size of the object is used as a clue to its distance. By the apparent size of a man we may judge whether he be a mile or a hundred yards away. Conversely, when we know the distance, we can employ it to form an estimate of the size of an object at that distance. Thus, if we know the approximate distance, we can be fairly sure whether the person we see is a man or a boy.

The seeming size of objects runs roughly, but not precisely, parallel with the size of the retinal image. We make a certain compensation for objects at considerable distances.*

* Much mystery has attached to the fact that the image on the retina is upside down, and still we see things right side up. This irrelevant wonder is like marvelling how we can see a sphere, when the cortical cells responsible for our seeing are arranged in a shapeless mass. The fact is, we have no direct personal consciousness of either retina or brain cells. The *psychical* image is a thing entirely distinct from the retinal image. To speak of the parts of this psychical image as having one position rather than another is simply equivalent to saying that a certain set of motions is necessary to pass from one part to another of the object which it represents. To pass from what we call the bottom to the top means a certain series of eye movements, or hand movements, and so on.

The distinctness of the perceptual image is another criterion. Things seen dimly, other things equal, are judged to be far away. Objects near at hand seen dimly in this way, as during a fog, seem much magnified in size. We have dimness, the sign of distance, conjoined with a large image, and we consequently judge the object to be much larger than it is, because of its seeming distance. The contrary form of this confusion is experienced by persons going into the mountains for the first time. The unaccustomed atmospheric clearness renders distant objects unwontedly distinct, and so they are misjudged as much nearer and much smaller than they really are. Color also affects such judgments. Mountains having a greenish hue appear nearer than those of a violet or bluish tinge. Our judgments of distance are seriously disturbed, also, when deprived of the assistance of familiar intermediary objects. Persons unacquainted with the sea are wholly unable to guess accurately the distance of vessels or other objects across the water. Light and shadow give us many trustworthy indications of contour, and even the absolute brightness of the light seems to affect our judgment, bright objects seeming to be nearer than those which are less bright. We use these various criteria of form and distance habitually and without much of any conscious recognition of the facts upon which our perceptions are based; but that the factors mentioned are really operative and essential is shown by the changes our judgments undergo the moment one of them is altered.

Inaccuracies of Space Perception.—Despite its general accuracy, our visual perception is subject to sundry eccentricities, the precise causes of which we cannot pause to discuss. In many cases, indeed, the reasons for them are far from certain, as we intimated when discussing illusion. Most of them we manage to disregard in practical affairs. The upper portions of vertically symmetrical figures look larger than the lower portions. The printed letter S and the figure 8 illustrate the supplementary principle, that to make the top and bottom parts appear of equal size the bottom one must be made larger. The seeming size of objects is affected by their surroundings. Figures 56 and 57 illustrate this. We might mention many other instances, but space forbids.

In the establishment of effective correlations among our several sources of space perception, there can be no question, as we have previously insisted, that movement is the great factor. Objects touched are, by the movement of the eyes, at the same time seen. The superposition of one object upon another, and the successive passing of one hand after the other over the things we touch, must rapidly serve to build up

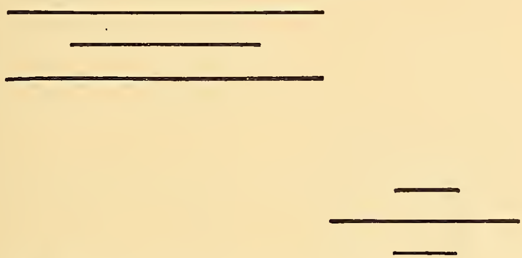

FIG. 56. The middle lines of the two figures are of equal length. To most observers the lower one seems shorter. This result is attributed to the effect of the surrounding lines.

elaborate space preceptions upon the foundation of local signs, some of which are visual and some tactual. Our space, as we know it in adult consciousness, is, then, a distinctly synthetic and relational affair, developed from two or three distinct sensory sources, through the intermediation of localising and exploring movements. The unity which it possesses is primarily a practical unity brought about by the motor reactions which we make upon it.

Space Limen.—We may add for those who are interested in the quantitative aspect of these matters, that the limen for space perception in vision has generally been given at 60″, this being the angular distance at which two lines can just be distinguished as two. Recent experimenters report a far smaller angle, one observer finding the limen at 15″, another at 2.5″. In touch, the threshold for the detecting of two points as two is, for the finger-tips, roughly, 2 mm. The tongue is even more sensitive. But this can hardly be called the space limen with propriety, for *single points* are felt as having some extension. Apart from the tongue, the finger-tips are the most delicate tactual surfaces. Speaking generally, the delicacy of tactual space perception seems to be a function, first of the richness of nervous innervation (those places which are most richly innervated being generally most sensitive), and s e c o n d, of practice, or use.

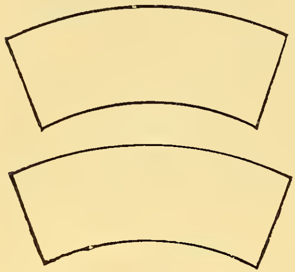

FIG. 57.

These figures are of equal size. To most persons the upper one appears smaller. One is perhaps misled by the disparity in length of the adjacent lines forming the top of the lower figure and the bottom of the upper one.

Localisation of Sound.—Although we may not admit that auditory sensations are themselves spatial, we cannot question that we localise sounds with considerable accuracy. In our view, however, this localisation occurs in the space world of vision-touch-movement. The two most important factors in the localisation of sound are, first, the relative amplitude of the sound waves distributed to the two ears, and, second, the acoustic complexity of the sound waves. If the right ear is more violently stimulated than the left, we locate the stimulus on the right side of the body. If the two ears are stimulated equally, we judge the sound to be somewhere in the median vertical plane, at right angles to the line joining the ears. But of the precise point in this plane we are very uncertain.

With sounds that have many partial tones, these tones, especially the higher ones, are so affected by the bones of the head and by the external ear, that they reach the two ears in distinctly different condition, save when they occur in the median plane. In consequence the timbre of complex sounds differs with their direction; and it seems quite certain that we employ these differences in our auditory localisation of direction, and possibly also of distance. Our auditory estimates of distance, however, are highly inexact. To put it graphically, a sound on the right side may be heard as a fusion of tones *a-b-c-d-e-f* by the right ear, whereas by the left ear it could only be heard as a fusion of *a-b-c*. Now if the sound be moved to a point a little to the right of straight back, the right ear gets *a-b-c-d-e*, the left ear *a-b-c-d*. Our perception of the sound is of course always a fusion of the increment coming from the two ears. But our illustration may serve to show how these differences in timbre may act as local indices. Recent experiments indicate that under certain circumstances at least the *phase* in which the sound wave impinges upon the ear may be a determining factor in localisation. Most persons seem to make their localisation of sounds either in the form of visual imagery, or in the form of quasi-reflex localising movements of head and eye. Many animals of course employ the movements of the conch of the ear to make their localisations, a method rendered impracticable for men by reason of the atrophy of the controlling muscles. It is possible that cutaneous sensations from the drum membrane are of some consequence in certain localisations, but the evidence for this is hardly conclusive.

Functions of Space Perception.—It is not necessary to repeat the statements made in the last chapter concerning the general functions of perception, although they all hold true here. Perception is the process by which we first become conscious of things, or objects. In the preceding chapter we were chiefly engaged in analysing the peculiarities of this awareness of "thingness," or "thinghood," as it is sometimes called, without direct reference to the spatial and temporal characteristics involved in it. But it must not be forgotten that things are encountered as parts of a spatial and temporal world, and it is through our ability to perceive space relations that we are enabled to adjust ourselves to the distance, form and size of objects. One has but to recall the fundamental nature of these spatial attributes of objects in the world of common daily experience to appreciate how indispensable our space perceptions are to all effective conduct. One incapable of discerning the size, shape and distance of things would be practically helpless.

II. TIME.

Space and Time.—Although certain of our sensations may not, perhaps, contribute directly to our consciousness of space, all of them participate in furnishing us our sense of time. We are probably never wholly oblivious to the feeling of passing time, and now and then it monopolises our entire attention. Unlike our perception of space, however, our direct perception of time is a very limited, cramped sort of an affair. The eye permits us to range over the vast distances of interstellar space, but our perception of time, so far as it is an immediate sensory process, never gets far beyond the present moment. It seems to be based upon our awareness of the changes occurring in consciousness itself.

Primary Characteristics of Time Perception.—We may perceive the passing of time, either in the form of a mere vague *duration,* or as an *interval,* depending upon whether we give our attention to the *filling* of the period, or to its *limiting stimuli.* In either case what we become aware of is never a mere *point* of time, sharply marked off from that which has gone before and that which follows. It is always a consciousness of an *extent* of time which confronts us, however limited this extent may be.

The Specious Present.—This consciousness of the sensibly present moment is often referred to as the "specious present" —a phrase suggested by E. R. Clay. This specious present seems to owe its extended nature to the fact that objects which have once been in consciousness do not drop out instantaneously, but fade out often somewhat slowly. We are at any given moment, therefore, aware in the fringe of consciousness not only of that which a moment ago engaged our attention but also of that which a moment hence is more fully to occupy us. This period of waning which our thoughts display before passing entirely out of the field of consciousness is often entitled the period of "primary memory." In any case our direct perception of the passing of time is simply this process in which from moment to moment we become aware of the coming and going among our conscious activities. Evidently the scope of such a perceptual process must be very circumscribed. As a matter of fact our *direct,* as distinguished from our indirect and inferred, consciousness of time never exceeds a few seconds. Under favourable conditions it may mount up to twelve seconds or thereabouts, but ordinarily it is much shorter.

Factors in Direct Perception of Time.—Although all the senses may be employed for this purpose, hearing is the sense from which we gain our most accurate direct perception of time relations. Touch and the motor sensations rank next, and in actual practice generally operate with hearing. If we are attempting to judge accurately the length of two time intervals we tend strongly to tap, or make other rhythmical movements, and our judgment is much assisted by these movements. The shortest interval which we can feel as a time period between two sounds is about 1-50 to 1-80 of a second. Sounds succeeding one another more rapidly than this we may distinguish as qualitatively different from absolutely simultaneous sounds, but we hardly recognise them as temporally separate. Furthermore, we may feel as successive two stimuli which are objectively simultaneous. This is said to be true of the combination of a noise and a light sensation.

When the auditory stimuli follow each other at the rate of less than 1-2 second, we seem to sense the sequence in one way. When they come at intervals of 1-2 second to 3 seconds, we have a different mode of reaction. These latter cases we feel distinctly as durations. Probably the sensory content of these durations is largely made up of kinæsthetic sensations, especially from the respiratory muscles. The shorter intervals first mentioned we sense more as "moments," although they may vary considerably in actual length. They are in no true sense, therefore, felt as mere points in time. If we compare intervals longer than three seconds we find ourselves beginning to employ our consciousness of the number of sensations, or ideas, which come into the mind. We tend to overestimate very small intervals and to underestimate long intervals. The region of relatively correct judgment may be called the indifference zone. This is about 6-10 to 7-10 of a second.

Much as in the case of space perception, we judge richly filled intervals as longer than relatively vacant intervals. "Empty time" is a myth. We always have some consciousness of change, so long as we are conscious at all. We are also subject to illusions and to the effect of contrast, as in spatial processes. An interval seems shorter when preceded by a long interval than when preceded by a short one, and *vice versa*. An interval bounded by intense stimuli seems shorter than one with more moderate limiting stimuli. If our attention is very much engaged upon some expected event we may perceive it as coming before another event which it actually follows.

Generally speaking, our consciousness of time, as such, is proportional to our interest and absorption in the occupation of the moment. When we are bored, as in waiting for a train, or when ill, time drags outrageously. We may be conscious of every loathsome increment in it. When, on the other hand, we are thoroughly interested, long intervals may pass as in a flash. Certain drugs, such as hashish, have a curious effect upon our time perception, lending a vastly magnified perspective to it, so that events of a moment since seem ages remote. Dreams often display a similar distortion.

Indirect Time Perception.—Clearly our practical use of time relations depends largely on other processes than those of direct perception. For our consciousness of the hour, the day, and the year we resort to the sun and moon, to clocks, watches, calendars and other indirect means of information. Despite the fact that the subject does not bear immediately upon *perception,* it will be convenient to add a few words at this point upon one or two general features of our time consciousness.

General Characteristics of the Apprehension of Time Relations.—When we recall intervals of time which belong to the more or less remote past, we immediately remark a seeming paradox. Intervals which actually passed very slowly for us appear retrospectively to have been very brief. Thus, a tedious illness, when time palled upon us almost beyond endurance, may in recollection seem very short, although we actually know it occupied weeks. Conversely, intervals which passed in a twinkling appear to us in memory as long drawn out. The reason for the paradox is obvious. Our feeling for the length of these remembered intervals depends upon the amount of content, the number of events, which we can read back into them. The interesting intervals are full of such things, whereas the tedious periods are characterised by a depressing sameness, which affords our memory little or nothing to lay hold upon.

The change which comes over our attitude towards the various intervals of time as we grow older is an interesting and familiar phenomenon. In childhood the year seems interminable, the month majestic, the week momentous, and even the day important, to say nothing of the hour. In adult years all these periods shrink, the longest ones most markedly. Our attitude towards very short intervals, like the second and the minute, undergoes no change of which we can speak confidently.

Our notion of very remote times, whether thought of as past or future, is gotten in an almost wholly symbolic way, like our notion of vast numbers. The difference between 2000 B. C. and 6000 B. C. is a thing for which we have a cold intellectual apprehension, quite distinct from our feeling for the difference between 1776 and 1860.

Neural Basis of Time Perception.—We can say very little about the neural basis of time perception, and that little is largely of an inferential and speculative character. If the awareness of passing time rests, as we have maintained, upon our consciousness of the waxing and waning of the thought processes, there should be some fairly constant phase of the cortical activity corresponding to this conscious metabolism. We may suppose this to consist in the rising and falling of the pulses of neural activity throughout the various regions of the cortex. Time consciousness would depend, therefore, upon the overlapping of the activity of various groups of neurones. Beyond some such vague formulation as this we cannot go. Let it be remarked, however, that the conception, though vague is wholly intelligible.

Physiological Time Sense.—In connection with the neural basis of time perception, we may mention two striking and perplexing peculiarities which many persons possess. One of these is the capacity for telling with great accuracy the precise hour, whether by day or by night, without any recourse to watch or clock, and without any deliberate computation or estimate. The other is the ability to awaken exactly at any given hour, without any preliminary disturbance of the soundness of sleep. Both of these performances probably rest upon some sort of recognition by the cortical centres of the rhythm of physiological activities constantly in progress in the body. But after all is said, the matter remains something of a mystery, a mystery which is enhanced, rather than removed, by the familiar attempt to find an explanation in "subconscious" activities. It suggests certain of the experiences met with in post-hypnotic suggestion. Of hypnotism itself we shall have something to say in the final chapter of this book.

Functions of Time Perception.—In addition to the perceptual functions already mentioned, it only remains to call attention explicitly to the part played by perceptions of time. Under the conditions of ordinary life we rely very largely upon the *indirect* means of determining time, to which reference has been made at an earlier point. This is altogther natural, because our ability to discriminate with accuracy the longer intervals of time is notoriously imperfect. Nevertheless, the significance of our direct awareness of the passage of time is well brought out by the consequences of complete absorption in some occupation, as a result of which we suddenly find that we have failed to keep an important engagement. In a world in which events occur in temporal sequence a measure of constant, or at least frequent, alertness to the flight of time is an essential precondition to effective conduct. The constant change in progress in the events of the external world is itself a vigorous corrective of any tendency toward entire obliviousness to the movement of time, for by virtue of this change we are incessantly subjected to fresh stimulations. Although we come to rely so extensively upon artificial means for determining time, it may be questioned whether we are ever long without a direct awareness of its passage. By means of space perception we accommodate to the world of tri-dimensional coexistencies. By means of time perception, direct and indirect, we accommodate to the world of sequential events.

CHAPTER VIII

IMAGINATION

General Account of Re-presentation.—In the preceding chapters we have seen that even in perceptual processes where the sense organs are most obviously engaged, the effects of past experience are very conspicuous. This fact will suggest at once the probable difficulty of establishing any absolute line of demarcation between processes of perception and those which, in common untechnical language, we call memory and imagination. We shall find as we go on that this difficulty is greater rather than less than our first impressions would indicate, and it will be well to come to the matter with the understanding that we are examining *various stages* in the development of a common process, rather than with any idea of meeting entirely separate and distinct kinds of mental activity. We called attention to this same point at the outset of our analysis of the cognitive functions.

Our study of habit brought out clearly the strong tendency of the nervous system to repeat again and again any action with which it has once successfully responded to a stimulus. The undoubted retention by the nervous organism of the modifications impressed upon it by the impact of the physical world, in what we call experience, is commonly designated "organic memory," and forms beyond question the physiological basis of conscious memory. Thus, in perception, as we have just seen, the sensory nerves may bring in excitations of as novel a character as you please, but the brain insists on responding to these stimulations in ways suggested by its previous experience. That is to say, it repeats in part some previous cerebral action. Similarly, we observe that from time to time thoughts flit through our minds which we have had before. This we may feel confident, from the facts we examined in chapter II, means a repetition in some measure of the cortical activities belonging to an earlier experience. Sometimes these thoughts are what we call memories, *i. e.*, they are thoughts of events in our past lives which we recognise as definitely portraying specific experiences. Sometimes they are what we call creations of fancy and imagination. But even in this case we shall find it difficult to convince ourselves that the materials of which such thoughts are constituted have not come to us, like those of clearly recognised memories, from the store-house of our past lives.

Although we shall postpone the detailed examination of memory until the next chapter, and must therefore anticipate somewhat the full proof of our assertion, we may lay down the general principle at once, that *all psychophysical activity involves a reinstatement, in part at least, of previous psychophysical processes.* Stated in terms of mental life alone, and reading the principle forward instead of backward, it would stand thus: *all the conscious processes of an individual enter as factors into the determination of his subsequent conscious activities.* With this general conception in mind, we have now to analyse the special form of representation known as imagination.

General Definition of Imagination.—The term imagination, in its ordinary use, is apt to suggest the fanciful and the unreal, the poetic and the purely æsthetic. We speak in this way of great poems as "works of imagination." We describe certain persons as of imaginative temperament when they are subject to romantic flights of fancy, etc. These implications are of course properly a part of the meaning of the word, when employed in its usual untechnical sense. But the psychologist uses the term in a broader way than this. In the preceding chapter we discussed the consciousness of objects present to the senses. Imagination, in the psychologist's meaning, might be called *the consciousness of objects not present to sense.* Thus, we can imagine a star which we do not see; we can imagine a melody which we do not hear, an odour which we do not actually smell, etc. Stated in the more usual way, imagination consists in the ideational revival of previous sensory excitations. Speaking broadly, both perception and imagination evidently involve the consciousness of objects, and their primary distinction from one another is to be found in the physiological fact that one arises immediately from a sense organ stimulation, while the other does not.

The principal psychical differences we pointed out in a previous chapter. The perceptual consciousness, which is peripherally originated, is almost invariably more vivid, enduring, detailed, and distinct than the centrally initiated process of imagination, and seems to be more coercive, to be somehow more definitely "given" to us. Imagery is generally more vacillating, more fragmentary and perhaps less provocative of movement. But the similarity of the one process to the other is quite as obvious, and quite as important, as their difference. This fact is well brought out by the familiar experience in which a new and fascinating melody 'runs in the head.' All day long we are obliged to hear it mentally, and from time to time we are irresistibly impelled to sing it or whistle it. Finally it wears out and disappears.

The stuff, so to speak, out of which visual *imagination* is made is apparently qualitatively the same kind of material as that out of which visual *perception* is made. Indeed, when we describe imagination as a consciousness of objects, we have already suggested that which is really the fact, *i. e.,* that all imagination is based in one way or another upon *previous perceptual* activities, and consequently the psychical material which we meet in imagination is all of a piece with the material which perception brings to us, and altogether like it, save that in imagination the fabric is often much faded and sometimes much cut up and pieced. So far as we approximate pure sensations in sense experience, so far do we have images reinstating approximately pure qualities as distinct from objects. Images of warmth, for instance, may have in them relatively little suggestion of objective character.

Analysis of Imagination. (A) Content.—If we were to ask a dozen persons to think of a rose for a few moments, and then relate for us the ideas which had passed through their minds, we should find that some of them had at once secured a mental picture of the rose in which the colour and the form were represented with considerable accuracy and detail. These persons evidently got visual images of the rose. Others would have found that the word "rose" came at once into mind, followed by other words such as "American Beauty," "red," "bud," etc. These words would, perhaps, have been *heard* mentally, and together with this mental hearing the more acute observers would report for us a similar consciousness of the sensations of movement which arise from the throat and lips when one is enunciating the words. This group of persons would have experienced auditory and motor imagery. Still others would report a faint consciousness of the odour of the rose, which involves olfactory imagery; and a few might tell us that they fancied they got tactual images, such as would arise from the thought of touching the soft petals. It might occur, although we should find this result rare, that some individual would report *all* of these images as passing through his mind in sequence.

It has been asserted that we have no genuine motor, or kinæsthetic, images, because every attempt to think of a movement results in our actually making the movement in a rudimentary way; so that we get a kinæsthetic *sensation* instead of a kinæsthetic *image*. There can be no doubt that this is often the case; *e. g.*, the effort to think how the word "back" sounds will by most persons be found to be accompanied by definite sensations in the tongue and throat. Moreover, there can be no doubt that the normal tendency is that kinæsthetic ideational excitement should produce movement, like other forms of ideational process. Meantime, there seems to be no reason in the nature of the case why we may not have kinæsthetic images in a form definitely distinguishable from the kinæsthetic sensations to which they may lead; and many observers insist that their introspection verifies the reality of these images.

According to the commonly accepted doctrine there are, theoretically at least, as many kinds of images as there are sense organs. If our experiment be amplified and a large number of persons be submitted to it, we shall find that it is much easier for most persons to secure with confidence accurate and reliable images of the visual, auditory, and motor varieties than it is to secure those of the gustatory, thermal, organic, and olfactory types. Tactual images seem to form a transition in difficulty of attainment from one class to the other. Later on we shall inquire into the probable reason for these differences. Moreover, we should find in the same way, if we gathered statistics upon the subject as others have done, that many persons, even though they can with sufficient effort command various forms of images, actually have their imagination in its ordinary use dominated by some one or two forms. From this observation has arisen the recognition of mental "types," and currency has been given to the division into "visiles," "audiles," "tactiles," "motiles," etc.

These types are, as we have just pointed out, seldom or never absolutely exclusive of one another. But they indicate the prevalent form of mental material. With most of us there appears to be a relatively good representation of several forms, especially the visual, auditory, tactual, and motor. In any event we find that specific images of one kind or another always constitute the content, the material, of imagination.

Image and Idea.—It may serve to clarify the terminology employed from this point on, if we pause to distinguish tentatively between the terms *image* and *idea.* So far as in our descriptions we have in mind the *sensuous content* of a thought, *e. g.,* its visual or auditory character, we use the term image. So far as we wish to emphasise in addition to, or in distinction from, this fact of sensuous constitution the purport, significance, or *meaning* of the image, we use the term idea. Images and ideas do not refer to two different states of consciousness, but to one and the same state, looked at now from the side of sensory character and antecedents, now from the side of meaning. Moreover, the two aspects vary from time to time in their relative prominence. Sometimes there is present to consciousness very little save the awareness of meaning. On other occasions the sensuous detail is profuse and noticeable. The matter will be discussed more fully in our analysis of the concept.

It should also be reiterated that in speaking of images as though they were distinct mental events, we do not mean to imply that the image constitutes the whole of consciousness at any given moment; nor that thought is made up of disconnected bits of stuff called images. We are simply indulging the kind of abstraction in which we frankly announced our purpose to indulge. Images merely represent, on the cognitive side, the more *substantive* moments in the onward flow of consciousness. They rise by indiscernible gradations out of antecedent conscious processes, and fade away into their successors without a vestige of abrupt separation. Moreover, any given image is merged in a setting of sensory processes representing the momentary bodily conditions, attitudes, etc., of which we made mention in discussing the physiological accompaniments of attention.

(B) Mode of Operation of Imagination.—If we watch the play of our images under different conditions, we observe regardless of the sense department to which they belong, certain marked peculiarities which evidently call for separate classification of some kind. In dreams, for example, there often appears to be the utmost chaos in the fashion in which the images succeed one another; and when we have regard to their composition and character, they occasionally seem to be utterly novel and bizarre inventions, the like of which we have never known in waking experience. The hobgoblins of nightmares, with their inconsequential torments, are illustrations of this sort of thing. On the other hand, in revery our minds occasionally wander off amid trains of images which are coherent in their relations to one another, and which evidently spring from recognisable experiences, of which they are in a measure faithful representations. Thus, the recollections of a journey may pass through our minds, diversified by excursions into connected fields of thought suggested by the various incidents of the trip. Can it be that these two forms of imagination are really identical? Is the process which brings back to mind the recollection of the sound of the multiplication table one and the same in kind with that which leads to the sudden perfection of an invention, or the inspiration of a fine verse? To answer this question in even a provisional way requires a closer examination of these two forms of imagination, to which psychologists have assigned the names "reproductive" and "productive" respectively.

Reproductive Imagination. — Reproductive imagination consists in the representation of perceptions, or images, which have previously appeared in our consciousness. Thus, I may close my eyes and obtain a visual image of the desk at which I am writing. Such an image would illustrate what psychologists mean by reproductive imagery, inasmuch as my imagination would in this case simply repeat, or reinstate, some conscious experience which has previously been present in my mind. Evidently at this rate the great mass of the events which we are able to remember would be recalled by means of reproductive imagination. Our ordinary memory processes would be instances of reproductive imagination, or, as it is sometimes called, re-presentation.

Productive Imagination.—Productive imagination on the other hand involves the appearance in consciousness of images which have never before entered the mind in their present order and form. Thus, the visual image of an eight-legged dog might be called up, although it is reasonably certain that most of us have never seen such an animal, nor even a picture of it. Such an image would illustrate, in a rough way, what is meant by productive, or constructive, imagination.

Now it is a favourite conceit of the untutored mind to suppose that it is possible mentally to create absolutely new materials for ideas, that it is possible to burst over the bounds of one's past experience and beget thoughts which are wholly novel. This is a flattering delusion which a little reflection will effectually dispel, although there is a distorted truth underlying the vanity of the belief.

In the case of the eight-legged dog it is clear that, although we may never have encountered just such a creature in any of our adventures, the superfluous legs with which we have endowed him, which constitute his sole claim to novelty, are merely as legs familiar items in every experience with the canine breed.

The productivity of our imagination consists, therefore, in the modest feat of putting together in a new way materials of a thoroughly familiar kind. Although in many instances the process is less purely mechanical than in the illustration above, there is, and can be, no question of our having originated *de novo* fresh elements of the psychical imagery. We shall find a similar thing true of any instance we might examine in which a genius has created a new poem, a new statue, a new melody or symphony, a new machine, or a new commercial process. Often the result is achieved by inspiration as we say. It is not consciously thought out. This is true of the great works of art, whether in literature or the plastic arts. At other times the result may issue from persistent thought processes which we should ordinarily call reasoning. The so-called scientific use of imagination is largely of this kind. In each and every case, startling as is the result, and novel as may be the combination in its entirety, the elements which have been thus ingeniously juxtaposed are all of them drawn in one way or another from the richness of the individual's previous experience.

The point mentioned earlier in the chapter must be borne in mind here, *i. e.*, that in the use of our imagery sensuous detail often drops largely into the background, leaving us its meaning as the conspicuous thing. But in this instance there is also intimate dependence upon previous knowledge. Productive imagination is productive, therefore, only within the limits set by the possibility of combining in new ways the materials of past states of consciousness, and in discerning among them relations previously unnoticed. But such limitations, be it said, afford scope for an amount of orginality and creative fertility which far surpass any human accomplishment thus far recorded.

When we give free rein to imagination and allow it to run undirected, the process is sometimes known as fancy. When the thought is directed and made subservient to some persistent purpose, we should commonly speak of the process as thinking, reasoning or reflecting. In such mental activities there will naturally be the most complicated intermingling of imagery elements of the productive and reproductive kinds.

Relation of Productive to Reproductive Imagination.— It appears at once from the foregoing statement that in one sense all productive imagination is really reproductive;

and that in consequence we have in the last analysis only one form of relation obtaining between our present imagery and our previous consciousness. Strictly speaking this is undoubtedly true. The differences which attract our attention to the seemingly distinct modes of imagination are primarily differences in the degree to which any given image, or any sequence of images, actually correspond *to the entirety of* some antecedent conscious event in our lives. When the correspondence is obvious, we think of the imagery as reproductive. When it is not, we are likely to credit it with creative characteristics, and justly so, within the limits which we have designated. It only remains to notice one peculiarity about reproductive imagery which serves to modify somewhat the purport of our conclusion.

It is altogether problematical whether any image is ever in a thorough-going way a *mere* reinstatement, or repetition, of a previous perception or image. I may to-day, for example, think by means of an auditory-motor image of the word psychology; I may do exactly the same thing to-morrow, and I shall then speak of having had the same image on two occasions. But it is clear in the first place that I cannot *prove* the two images to be really alike; for I can never get them side by side in my mind for comparison. When one is there, the other has gone, or has not yet arrived, as the case may be. Furthermore, if we turn to the considerations which we canvassed when we discussed the operations of the cerebral cortex, we shall find reason for thinking that no two images ever can be quite alike. For we saw that our consciousness, in which these images appear, and of which they are a part, apparently runs parallel with the brain activities; and it is quite certain that the brain, through its constant change of structure and tension, is never twice in precisely the same condition; and consequently is never in a position to lead twice to the same excitation of consciousness.

On the whole, then, it is perhaps nearer the truth to say that all imagination is productive, rather than reproductive. When we speak of having had the same image on several occasions, what we really mean is that we have had in this way images which we *employed to refer* to the same object. They have thus served our purpose quite as efficiently as they could have done by being actual copies, the one of the other.

The same thing is more obviously true as regards any image which purports to represent a perception. Functionally, as regards what it *does* for us, what it symbolises, it really does reinstate the perception; but it is not on this account necessarily an exact copy of the perception.

The distinction between reproductive and productive imagination must not, therefore, be conceived of as resting on ultimate differences. It marks a practical distinction, *i. e.*, in the degree to which present thoughts resemble previous thoughts, which is useful in enabling us to indicate significant variations in the operations of our imagery.

Successive Association of Images and Ideas.—This is a convenient point at which to consider the principles controlling the sequence of our ideas and images, as they pass through the mind. The so-called law of association, which has played historically so important a part in psychology, undertakes to formulate the facts under a single general principle, *i. e.*, the principle of habit. We have mentioned in an earlier chapter the phenomenon known as simultaneous association. The process which we are to examine at this juncture is designated successive association.

The law of association asserts that whenever two images, or ideas, have been at any time juxtaposed in the mind, there is a tendency, if the first of them recurs, for the other to come with it.

Experiments seem to show that there is also a tendency for the first idea to appear if the second be present in consciousness. That is to say, the associative nexus works in a measure backwards as well as forwards. Stated more generally it means that a part of any total train of thought is likely if brought to mind to reinstate the whole. Furthermore, the law asserts that so far as concerns the sequence of ideationally aroused imagery, no image ever comes into the foreground of consciousness unless it has been in some way connected with its immediate predecessor. The *order* of our thoughts is, in short, determined by our antecedent experience.

It is clear to the most casual reflection that this principle, if true, must operate under a number of definite limitations. We know, for example, that a given idea comes into the mind on one day with a certain set of accompaniments, and on another occasion presents itself with a wholly different escort.

Principles Controlling Association: A. Neural Basis.— How is such a variation to be accounted for? It is generally agreed nowadays that the *retention* or preservation of associative tendencies is primarily a property of neural processes. It is a physiological thing. When the ideas are actually *recalled,* mental processes are also involved and the act is a psychophysical one. If we follow James in formulating the associative relation in brain terms, we may say that the liability of any special cortical activity, such as x, connected with the thought x^1, to arouse any other cortical activity, such as y, connected with the thought y^1, is proportional to the *permeability* of the pathway joining the brain areas involved in the production of x and y, as compared with the permeability of all the other pathways leading from the brain area involved in x to other regions of the cortex. (Figure 58.) Now this permeability must be largely a function of previous use; that is to say, pathways which have by repeated employment become deep-cut in the brain tissues will, other things equal, be most pervious. Stated in purely psychological terms, this will mean that the oftener any two ideas have actually been associated with one another, the more chance there will be that if the first one appears in consciousness, the second one will accompany it. Moreover, in so far as the principle of association depends upon the law of habit in the cortex (and this undoubtedly is its foundation), it must apply to all forms of psychic life, as well as to ideas and images. This is, indeed, the fact, as we shall discover in our further study. But it is convenient to formulate the principle, as has been historically the accepted usage, in connection with ideas where its operation is particularly obvious.

B. Effect of Frequency, Intensity, and Recency of Association.—Among the many factors which must affect the permeability of the brain paths, three important ones are easily discernible. These are the frequency, intensity, and recency of associative connection.* Ideas which have been *frequently* associated evidently must be connected with neural activities which will tend, if once roused, to react in the regular *habitual* way. The ideas of Lincoln and the Civil War may serve to illustrate such frequent conjunctions. Ideas which have been connected with one another in some *vivid* experience will be connected with intense neural activities,

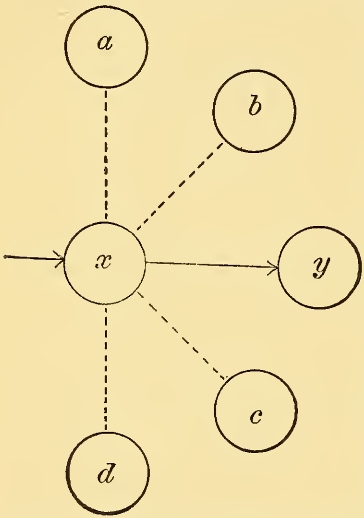

Fig. 58. Although pathways exist connecting the brain process x with the brain processes a, b, c, d, and y, if the pathway from x to y is more pervious than the others, the activity of x will be followed by the activity of y.

* It will be remembered that in chapter VI we noticed a similar group of factors influencing the formation of certain illusory perceptions.

whose modifications of the brain tissues will therefore tend to be relatively deep and permanent. People who have witnessed a great conflagration or a great disaster of any kind, especially if they were personally endangered, find the ideas of it welded firmly together. Often such experiences can be mentally reinstated with almost their original vividness and detail. Similarly, if two images have been *recently* associated, the pathways joining the brain tracts responsible for their accompanying cortical activities are likely to be open; and the recurrence of the first image may readily bring with it the reinstatement of the second. The idea of the presidency of the United States will to-day most often call up the idea of Roosevelt. Our illustrations may seem to be too exclusively suggestive of associations set up originally between perceptual processes, and to take too little account of associations established primarily between ideas. But the principles involved are the same and equally valid whether they are applied to perceptual or ideational conditions.

C. Influence of Context.—In actual experience associated ideas belong to more or less related trains of thought and the entire context helps to determine which of several possible ideas shall appear at a given moment. If the idea 7 times 9 pops into my head, it is promptly followed by the idea 63. If, however, 4 times 9 comes to my mind, the next idea is 36. In both cases the idea 9 is present, but the subsequent associate depends upon the special companion with which the idea 9 is united in the antecedent thought process. In a similar fashion our memory of special words in poetry depends upon the total mass of verbal associates with which they are surrounded. The word "mirth" occurs in two of the following lines, and taken alone might suggest either of the following groups of words. Taken with its predecessors it rarely fails to awaken its correct consequents.

"And, if I give thee honour due,
Mirth, admit me of thy crew,

"These delights if thou canst give,
Mirth, with thee I mean to live."

In cases of this kind the association is often between *motor reactions* of enunciation, rather than between the images of the words. We simply find ourselves making the proper enunciatory movements and that is the end of it.

Related to the general influence of context is a distinction which Miss Calkins has pointed out. In certain associative sequences the image which comes into the mind entirely displaces the one which previously held sway. She calls this type of case desistent association. Our illustrations have been chiefly of this type. In other cases, however, a part only of the departing image is lost, the rest being taken up into the new image which succeeds it. This she calls persistent association. For example, in revery the image of a face may come before the mind. Without undergoing other change, it may presently be seen as dark instead of fair. This analysis seems to touch upon a real distinction and the last illustration suggests the case of association by similarity of which mention will be made presently. But the distinction clearly introduces no basal alteration into the general nature of the principle controlling the ideational sequences.

D. Interest and Emotional Conditions.—It remains to remark one further factor of probably greater importance than those already mentioned in its effect in determining what associates shall recur with an idea at any given time. The factors mentioned hitherto bear principally upon the conditions controlling the *original fixation* of the association. The present factor refers in part to this, but more immediately to the circumstances attending the *revival*, the *recall*, of the train of thought. This is our momentary interest, the prevailing tendency of our attention. If our minds are dominantly engaged upon any line of thought, as when we are wrapt up in some absorbing problem, or plunged in some profound emotion, the ideas which flood our minds are almost wholly such as sustain intimate relations to the matter in hand. When we are overcome by sorrow all our thoughts centre about our grief. No other thoughts can gain a hearing from us. And the same thing is true in varying degree of any intense mental preoccupation. The *continuity of our interest* is therefore an influence of absolutely prime importance, accounting readily for the omission, as well as for the inclusion, of those ideas which we find in point of fact have actually been omitted from, or conjoined in, associative combinations. We see, then, that the principle of association, or cortical habit, is modified, not only by the changing relations among the factors of past experience already mentioned, *e. g.*, such as frequency and recency, but also by the present psychophysical conditions reflected in such things as our attention and interest. This means, so far as concerns the brain, that those pathways are normally most pervious which connect most intimately with the entire mass of ongoing brain processes. The astonishing vagaries of dream consciousness illustrate what may occur when all dominating purpose is removed and the associative machinery is allowed to run wild and uncontrolled.

E. Contiguity, Similarity, Contrast, Cause and Effect.— Psychologists have been interested in various types of association, which they have called association by contiguity, association by similarity, contrast, cause and effect, and the like. They are all reducible to the forms previously mentioned, but their prominence historically renders it expedient to dwell on them briefly.

Association by contiguity is essentially identical with certain of the processes of which we have been speaking heretofore. *A* suggests *B*, not because of any *internal* connection, but because the two have often been contiguous to one another. This contiguity is originally perceptual in character. The objects are actually present together to the physical senses. Events related to one another as cause and effect are commonly experienced in this way. All association is *primarily* dependent upon the contiguity of perceptual objects, as will be readily apprehended when the dependency of images upon perceptions is recalled. It must not be forgotten that objects perceived together ordinarily share in whatever interest may at the moment be dominant. Consequently it is probably rare that contiguity as a determinant of association operates independently of interest.

Ideas apparently follow one another at times, however, which could not have been previously experienced together, and in certain of these cases we remark at once that the two things suggested by the ideas are similar, contain an *internal element* of connection. We meet a total stranger, perhaps, and instantly observe the similarity to some absent friend. Poetry owes much of its witchery and charm to the delicate and unusual resemblances which the poet detects for us, as when he says:

> "So gladly, from the songs of modern speech
> Men turn, ...
> And through the music of the languid hours,
> They hear, like ocean on a Western beach
> The *surge* and *thunder* of the Odyssey."

All the more conspicuous forms of genius seem highly endowed with this type of association, which is undoubtedly a genuine form of mental activity. We shall err only if we suppose the consciousness of similarity to be the invariable antecedent of the association. As a matter of fact we often observe the similarity *after* the association has occurred, not before, as should be the case if it were strictly speaking a cause. But this is not always the case. For example, we frequently see strangers upon the street who look familiar to us, yet it may require several moments of reflection before we can recall the persons of whom they remind us. A number of psychologists have suggested that the brain activities involved in thoughts of two similar things are in part identical, and that consequently we have in their suggestion of one another a further instance of the principle of cortical habit. (Figure 59.) The brain processes x and y, having the similar thoughts x^1 and y^1 as their concomitants, possess a common brain activity z. When x is active, there is thus a chance that the excitation of z may stir up y, to which z also belongs. Oftentimes the elements of likeness between two objects are several, as in cases of personal resemblance. On other occasions the resemblance may reduce to a single element. But the principle of explanation is the same in either case.

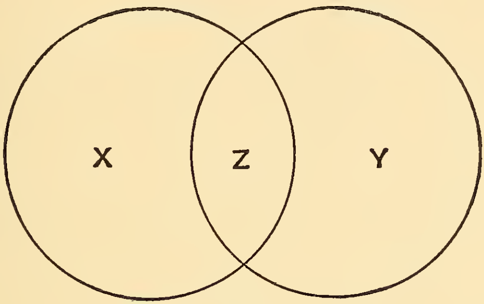

FIG. 59.

Association by contrast is really a modification of the contiguity and similarity classes. Things are not felt as contrasting unless they have some element of likeness, and to feel this likeness and difference commonly involves experiencing them together, as when we come to remark the contrast of black with white.

Even if no factors were operative in association, other than those we have already mentioned, we should find it practically impossible ever to *predict* with confidence what particular idea would come into the mind at any special moment. The law of association is not, therefore, a principle of *prediction,* but simply a formula for rendering intelligible in a schematic way the nature of the influences which control the order of our thoughts.

Neural Basis of Imagery.—Two divergent views are held as to the neural basis of imagery. We have already referred to these. The one maintains that *imagery* depends upon the activity of the same cortical regions that are involved in *perception.* The neural distinction between them is supposed to rest chiefly on differences in the intensity of the nervous excitation, coupled with a varying amount of difference in the extent to which the association areas are involved. The other view holds that the cortical regions involved are probably different in some important particulars, the areas concerned in the imagery processes of each of the senses lying perhaps along the borders of the regions devoted to the reception of the corresponding sense stimulations. This latter view is based largely on the implication of certain clinical cases already cited of persons who could perceive correctly without being able to call into mind images. This evidence the defenders of the view reinforce by other more ambiguous clinical facts and by their introspective conviction of a difference in the mental quality of the two states. The question must be regarded as still open, although the author feels that other interpretations of the clinical cases are possible than those adduced by the supporters of the second view. In any case it seems certain that the recognised sensory areas are involved to some extent in all ordinary processes of imagination, and the regions of the brain concerned can be identified by consulting chapter II.

Genesis and Function of Imagery.—The best clue to a correct understanding of the function of the image is to be gained, as in the case of all organic activities, when possible, by examining the conditions of its genesis, its appearance upon the field of psychophysical processes.

In several of the preceding chapters we have examined the evidence underlying our thesis, that consciousness appears at those points where the purely physiological mechanisms of the organism prove inadequate to cope with the requirements of its life. We have seen how the organism is endowed at birth with certain established sensory-motor neural pathways, by means of which it is enabled to respond with appropriate movements to certain primitive kinds of stimuli. We have also seen how, at the places where these responses are found insufficient, sensory consciousness appears; and we find, first, vague sensation processes, and then crude perception. In our study of attention, we noticed how the mind, working upon this crude perceptual matrix, succeeds in differentiating it into the multitude of qualities and objects which constitute the world of the adult. In seeking to detect the appearance and the function of imagery, we must remember, then, that from the outset of life organic activities are in progress and the sensory-motor activities in particular are in full swing. Each sensory stimulus is producing movements, which in turn are productive of fresh sensations. It is out from such a cycle of onward moving coördinations as these, therefore, that the image emerges; and if our previous hypothesis is really adequate to all the facts, it must be that the image is called forth by some need of the organism which the processes that we have already described are incompetent to satisfy. This is undoubtedly the case, and we have only to observe the evident limitations in the capacities of the perceptual processes, taken by themselves, to discern certain of the functions which our images subserve.

Perception enables its possessor to register in consciousness the particular object momentarily presented to the senses. But if consciousness never advanced beyond the merely perceptual stage, it is apparent that we could never develop any highly systematised and intelligent movements of response to environmental demands and opportunities. Intelligent deliberation would be impossible. We should always live in the immediate present, and our minds could consciously look neither backward nor forward. Now it is in the image, with its ability to carry such prospective and retrospective meanings that we find the psychical mechanism for accomplishing both these highly important functions.

If an organism is to be in the fullest possible measure master of its own fate, it must be able to bring to bear upon the incitations of any particular stimulus all the information which its total experience will permit. Its response must thus represent not only the intrinsic tendency to overt action, which belongs to the stimulus itself, but it must also represent and express all the tendencies to movement which remain as the result of yielding to previous incitations. Unless there be some organic arrangement of this kind, by means of which each act may represent with some adequacy the product of all related experiences in the past, one's actions can hardly rise above the level of haphazard reflexes. It is obvious that mere perception—although, as we have noticed, it does embody in a certain way the outcome of antecedent consciousness—does not in any sufficient manner provide for such a focussing of one's past experiences upon the selection of specific acts, as is demanded by the best accommodatory responses. Without the image we might make many appropriate reactions, but we should also make many more inappropriate ones than we now do; and any high development of intelligence would be impossible.*

The image is, then, the primary psychical process by means of which we bring into mind at need the experiences of the past. It is also the means by which we forecast the future. If I wish to remember what I read yesterday, I accomplish it by summoning images which represent the experiences at issue. If I wish to decide which of several lines of conduct I had best pursue, or which of several possible acts my enemy

*The limitations of animal intelligence are largely to be accounted for by the lack of well-developed processes of the image-idea type.

is likely to hit upon, I do it in either case by the use of images, which serve me in my tentative prognostication. These images may of course be of any variety, but in my own case they are likely to be largely visual—images of objects, or scenes—and auditory-motor images of words, for my own thinking goes on largely in these terms. Moreover, they may be extremely vague and their sensuous detail be almost swamped in the meaning which they convey. But, whatever its form, it is the image which thus affords us the method whereby we shake off the shackles of the world of objects immediately present to sense, and secure the freedom to overstep the limits of space and time as our fancy, or our necessity, may dictate.

Of certain of the important uses to which man has put his imagination—in the large sense of the term—in science and art, myth and religion, we shall refer in a later chapter. Here we are preoccupied with the more rudimentary aspects of the process.

If we have correctly diagnosed the chief function of our imagery we may be certain that it makes its first appearance at a very early stage in the conscious life of the human being. For obvious reasons it is not possible to designate the precise moment in the unfolding of the life of the mind at which the image is clearly and distinctly differentiated from the vague matrix of sensory-motor activities which we have seen characterising the first experiences of the child. But we may be confident that it is beginning to emerge in some sense departments, whenever we see unmistakable signs of volition, say at about the twelfth week in most children; and there is no reason why it may not be present, in a crude, indefinite way, from the beginning of extra-uterine life.

The Connection of Imagery with the Exercise of the Senses.—The development of imagery runs parallel in a measure with that of perception, with which, as we saw in the previous chapter, it is very intimately connected. It holds to reason, without any elaborate justification, that if any sense organ is allowed to go unused, or is used infrequently, the imagery belonging to that special sense cannot develop freely. In confirmation of this general assertion we have but to notice that the imagery which most of us find we can command with greatest accuracy and flexibility is that belonging to the perceptual processes with which we are most intimately familiar, *i. e.*, vision, hearing, movement, and touch. Compared with these, our images of temperature, smell, and taste are relatively impoverished. Moreover, children who lose their sight before they are five years old commonly lose all their visual images, thus exhibiting further evidence of the connection of the image with sense organ activity. Nevertheless, we have to admit that we display individual peculiarities and preferences in the kind of imagery which we employ that cannot be satisfactorily explained in terms of sense organ activities. The eye and the ear may be used with indifferent frequency and seeming effectiveness, and still the imagery be dominantly of either the visual or auditory kind. Differences of this sort probably rest upon unassignable organic variations in the cerebral cortex.

The Training of Imagery.—If we examine the type of development which characterises the growth of any special form of imagery, such, for example, as the visual, we shall find that two distinct tendencies are discernible. We find (1) that the number of objects which can be simultaneously visualised increases, and (2) that the vividness, detail, and definiteness of the image increases. It is astonishing to observe how rapidly this capacity for visualising unfolds in response to a little systematic effort and practice. By devoting to the task a few minutes each day for a week, one may learn to visualise with great detail and remarkable accuracy the form, size, colour, etc., of even large and complex objects, such, for example, as great buildings. Frequently at the outset we find that our images are relatively faint, meagre, and unstable; they lack vividness and veracity in colour, detail in form, and appropriate dimensions in size. Images of other varieties, auditory, for instance, are similarly defective at times, and yield as a rule to discipline, with a corresponding form of development.

But after all, the important development of our imagery is not to be found by inquiring for such changes as we thus detect, when we consider it of and by itself apart from its place in the totality of psychophysical activity. The essential thing is the increase in the dexterity with which we employ it, and the growth in the efficiency with which it serves its special purpose in the economy of the organism. We have already commented upon its principal function. It is the psychical device by which we are enabled consciously to focalise upon our acts the lessons of our previous relevant experiences, and through which we forecast the future in the light of the past.

To perform this function with the greatest ease, promptness, and efficiency is the goal toward which the development of our imagery tends, both in those cases where we, as psychologists, purposely bend our efforts in that direction, and also in those cases characterising ordinary practical life, in which our attention is concentrated upon, and absorbed in, the execution of some act, and for the moment is oblivious to the means employed.

We have already, in an earlier chapter, outlined the general nature of this development, and we need hardly do more here than refer to the significant facts, and cite an instance or two of the process involved. If I wish to express some proposition with the greatest possible force and clearness, I go about it by calling into my mind auditory-motor word images. Clearly I might use other kinds of imagery without affecting the relations which we are now examining. As a matter of fact I generally use, as do most persons under these conditions, auditory and kinæsthetic imagery. From among these word images I select that combination which appeals to my judgment as most appropriate and effective. Evidently the success which I achieve will be in part conditioned by the extent and richness of the images which I am actually able to summon. We speak sometimes of persons possessing a rich vocabulary. In the case of our illustration, my possession of a good vocabulary means, when stated in strictly psychological terms, that I can command a large and effective group of auditory-motor word images.

As a child my imagery of the verbal kind is necessarily circumscribed in amount and phlegmatic in operation. When adult years are reached the amount of the available imagery is ordinarily much augmented, but unless there be discipline in its actual *use,* it is commonly found that much investment of time and effort is needed in order to secure the best and most expressive terms. The only real and infallible means of training one's imagery for such actual operations is found in the definite use of it, either by writing or speaking. Practice is here, as elsewhere, the one invariable clue to the highest attainable success. The business of such imagery is always to be found in some *act,* and the only way to develop it and make it reliable and efficient is by *working* it. For various reasons, which we need not pause to discuss (perhaps largely due to emotional conditions), the possession of a good vocabulary for writing purposes does not necessarily carry with it a rich vocabulary for speaking; and in less degree the converse is true. One commonly requires separate training for each form of activity, if the best results are to be attained.

Imagery and Motor Habit.—When we were discussing the principle of habit we observed that all such coördinations as those which we have just mentioned tend, under the influence of practice, to become essentially automatic; and that consciousness consequently tends to disappear from their control. If this be always the case the idea is at once suggested that in such a process as is involved in our illustration, *i. e.*, the process of linguistic expression, the same tendency should be in evidence. I believe this to be actually the fact, and I think a little observation will confirm the position. We shall have occasion to examine the question more at length when we discuss later on the relation of language to reasoning, but a word or two may properly be inserted here.

Just in the degree to which our linguistic expression involves thoroughly familiar ideas, and deals with familiar situations, do we find our consciousness of definite imagery vague and indistinct. A student inquires: "What did you mention as the date of the battle of Waterloo?" Instantly, almost without any definite consciousness of what I am about to say, I find I have replied—"1815." But when the expression is of some relatively unfamiliar idea, when the thought presents the possibility of several discrepant modes of utterance, I promptly become aware of imagery. Not always verbal imagery of course. That consideration is wholly secondary. But imagery of one kind or another I always find when the coördination required cannot be executed in the purely—or almost purely—habitual manner. If the situations with which we have to cope by means of speech were more widely fixed, instead of being, as they are in fact, relatively unstable and fluid, relatively changeable, I see no reason to doubt that speech, like walking, might become essentially automatic—as I believe it to be in part already.

Summarising, then, we may say that all imagery arises out of perceptual activities, upon which its appearance is, therefore, most immediately dependent; it develops by use in the actual processes of controlling action, and develops its real functions in no other way. This accounts for its appearance in greatest profusion in connection with those sense processes which are most significant for human life. It tends to drop away after it has served, in the general congeries of consciousness, to establish effective habits.

CHAPTER IX

MEMORY

Memory and Imagination.—A considerable portion of the mental events which we examined in the last chapter as instances of imagination, might with propriety have been described as phases of memory. In our common use of the term "memory," we mean to indicate such processes as involve recollection in any fashion whatever. We say in this way that our memory informs us that Napoleon was imprisoned at St. Helena; that $8 \times 7 = 56$; that yesterday was rainy, etc. We also speak of remembering that on a certain occasion we made a certain remark to a certain individual. Evidently these illustrations might all be described as cases of reproductive imagination, for they all involve reproductive imagery. We may be reasonably sure at once, then, that conscious memory and imagination have one point at least in common, *i. e.*, the image.

But there is one important difference between memory, in the more precise meaning of the word, and mere imagination, which makes it desirable to devote a separate chapter to its study. We might go on indefinitely having similar, or even identical, images pass through our minds, and, if we did not recognise them as having been previously portions of our experience, we should never in any strict sense be able to speak of our having a memory process. In memory, our consciousness not only re-presents old experiences to us, but we are aware of the ideas thus brought to us as actually standing for items of our previous states of consciousness. If I am turning over in my mind the wisdom of making a journey to India, the thoughts which come into my mind are brought there by some form of reinstatement of knowledge which I have gained on some earlier occasion. Productive, or reproductive, processes of ideation are at work. But my attention may be wholly monopolised with the reference of these thoughts to the future. They may not at any point in my thinking present themselves as mere exponents of my antecedent experiences. I think of India as an interesting country, and my attitude is of course determined by things which I have previously learned about it. But this fact of my having gotten my information in some moment of my earlier life may drop wholly out of sight in my enthusiasm over the knowledge itself. Clearly, then, there is a distinction between the mere reappearance of ideas in consciousness, and the fact of memory, as involving *recognition* of these ideas as elements in my *own past* history. All conscious memory is reproductive imagination, but not all reproductive imagination is memory.

Definition of Memory.—We may define memory, then, with more preciseness than we have before attempted, by quoting James' words. "Memory proper—*is the knowledge of an event or fact,* of which meantime we have not been thinking with the additional consciousness that *we have thought, or experienced it before.*"

Method of Recall.—Let us take a specific instance of memory as thus defined and examine it. Suppose we attempt to recall where we were and what we were doing at 10 o'clock on the fifteenth day of last month. Ordinarily we shall be obliged to begin by remembering upon what day of the week that month began, and this in turn may require our remembering upon what day the present month came in. Let us suppose that we find in this way that the fifteenth of the preceding month fell upon a Tuesday. If our life is subject to a fixed routine, this will generally suffice to give us the clue to our whereabouts and doings at the hour suggested. After a moment's reflection we remember, perhaps, that we were in the library reading American history, and upon a little more reflection we may recall what other persons were in the room, and what portions of the text we were reading.

Memory and Association, or Cerebral Habit.—This analysis at once reveals what we shall find true in any case we may select, *i. e.*, that we call back our memory ideas, or images, by means of ideas which are associated with them. In order to solve the problem set us by the question in our illustration, we began by calling into mind ideas which we knew to be connected with the solution. In this way, little by little, we obtain the clue to our occupation at the time suggested. Memory depends, then, for its operation upon the principle of association, and this principle is in the last analysis identical with the law of habit in the cortical processes of the cerebrum, as was explained in the previous chapter. This physiological aspect of the matter is particularly well shown in cases where the recall takes place in the form of motor acts rather than in definite ideas. If I am asked for the street address of a friend, the reply may come instantly in the from of *spoken* words and often quite without any preliminary ideational process. The preservation by the nervous system of acquired tendencies to action is called "organic memory," as has already been stated.

Memory and Imagery.—If we inquire into the nature of the mental content disclosed in our conscious memory, we find that it is made up of images—visual, auditory, motor, etc. When we reach the goal of our endeavour, and succeed in recalling our presence in the library, we discover that the content of our thought is not only made up of images, but that over and above this fact is to be remarked the peculiar character of the imagery. Just in the measure in which our recollection is detailed and confident, we shall ordinarily find the imagery profuse and exact in its representation of the temporal and spatial order of the events and objects present to consciousness in the original experience. However, some persons execute almost all their thinking, including the process of recall, with a highly schematic sort of imagery which lacks detail and is extremely fleeting and unstable. The *meaning* of their conscious states is for them the persistently dominant thing and to the other aspects of their experience they remain consistently oblivious.

Memory and Recognition.—One still more important peculiarity is noticeable in this case of memory which we are analysing. After we have, by means of associated ideas, gotten into mind our whereabouts and acts at the time named, and after the imagery portraying our situation has been developed in consciousness, it is still necessary, if this is not all to be futile, that we should *recognise, identify,* and assent to the meaning of the ideas thus brought before our notice, as indicating the actual experience to be recalled. This fact of recognition we have previously emphasised as a distinguishing mark of memory when compared with imagination. It seems to be an ultimate and unanalysable property of consciousness. But however much it may baffle our attempts to dissect it, there can be no question of its fundamental import, and we must accordingly take account of it.

Memory an Outgrowth of Recognition.—It seems on the whole probable that memory, in the meaning of our definition, has grown out of a cruder process of recognition which, although it is now no longer sole proprietor of the activity, still accompanies the memory act in its elaborate forms as a basal and indispensable characteristic. If we examine, for example, the actions of an infant, we very early observe evidence of the recognition of objects. Thus, the mother's face, the sounds of preparing food, the contact sensations occasioned when clothing is put on or off, are all of them recognised at a period when it would be hazardous to assume that any independent memory imagery has as yet become disengaged from the general sensory continuum of consciousness.

Clearly then, the recognition process may begin with conscious events which are dominantly of the sensory and perceptual kind; whereas our contact with it thus far in our study has been primarily in connection with representational activities of the centrally initiated character.

Conditions of Sensory Recognition.—When we consider the neural conditions under which sensory recognition arises in the young babe, it is immediately suggested to us that recognition depends primarily upon the reëxcitation of pathways in the nervous system over which nervous impulses have previously travelled. The organic reaction which such stimulation sets up finds an echo in consciousness, which is probably the beginning of recognition. If we take this fact of recognition, in connection with the other facts we noticed when describing the beginnings of habit, we shall secure a deeper insight into the mode of development peculiar to the process here at issue. It may be said at once that recognition plays (implicitly or explicitly) a fundamentally important part in every one of the cognitive operations, from perception through memory up to reasoning.

Take the case of a child learning to recognise its mother. At first, when the mother takes the child up to be fed, the visual, tactual, and gustatory stimulations set up miscellaneous movements which are in the main uncoördinated and utterly variable. Little by little, however, as these sense impressions are repeated, and their agreeable consequences are experienced, the movements tend, after the manner we have already described, to settle down into the relatively coördinated groups which the experience encourages. Smiling, gurgling, jerking the limbs in movements anticipatory of being taken up, rapidly appear and become fixed as habits.

Very quickly, then, these repeated sense impressions set up sensory-motor coördinations, of which the conscious process of recognition is the psychical accompaniment. These impressions promptly come to mean certain movements. Indeed, the movements are actually initiated by the impressions, and recognition is the mental state which observes, assents to, and in a sense guides, these physiological responses. As the responses become more and more automatic, the psychical part of the activity tends to evaporate, as we have so often pointed out. In just the measure in which this occurs do we cease to have any clear, definite, vital sense of familiarity, any tingling thrill of recognition. This is illustrated in adult life by the "matter of course" manner in which we respond to the thousand and one objects which we see every day—the books, papers, ink-stand and pens on our desks, the tables, chairs, windows and lamps in our rooms, the trees on our familiar streets, the shape and colour of our own houses, etc. We do the appropriate things in the presence of these objects and such overt acts on our part constitute in cases of this kind substantially the sole expressions of recognition. Practically we recognise all these things of course, but it is with a relatively automatic, dim kind of consciousness, which contrasts sharply with the vivacity and distinctness of the feeling which we get upon first seeing these same objects after prolonged absence. As development proceeds, the overt movements themselves often become superfluous and are largely inhibited, or at least they tend to become nascent; they are resolved into mere transitory attitudes.

We may feel moderately confident, therefore, that recognition of the sensory variety rests upon the reinstatement of acquired sensory-motor coördinations; *i. e.,* on the genetic side it displays a period of conflict of impulses and movements with maladjustment, a period of increasingly efficient adaptation, and a final period in which the conscious factor tends to drop out, sometimes apparently doing this, sometimes stopping just short of disappearance.

Conditions of Ideational Recognition.—When we recognise ideas, or images, in distinction from perceptions, as having previously occupied our consciousness, the strictly mental features of the case do not differ materially from those we have just described. We are ordinarily, perhaps, more definitely aware of the fringe of suggested images with which an idea that we recognise promptly surrounds itself, although this is apparently by no means an invariable feature of recognition. But the production of an emotional reaction, or mood, which we may name the familiarity feeling, is common to both the sensory and the ideational forms of recognition. Generally, but not always, the act of recognition is agreeable, and this, too, is true whether the act be of the sensory or the ideational kind. Probably the mere act of recognition is, as such, always agreeable, although the object, or content of the thought recognised, is of course sometimes quite otherwise. Moreover, both kinds of recognition, sensory and ideational, may vary almost indefinitely as regards the distinctness and the degree of elaboration belonging to the various parts of the process. We may thus find that an idea which comes into our mind—for example, the visual image of some person's face—calls up the vague feeling "familiar," "seen before," and nothing more. Or it may surround itself with a number of other images and we may at once recognise it as the face of a speaker whom we heard last week. In such cases words are very likely to be called up, whether in the form of definite auditory images, or in the form mentioned in an earlier paragraph, as actual articulations. The person's name may be thus pronounced either aloud or under the breath. Here as in the case of sensory recognition, overt acts are frequently the conspicuous expressions of recognition.

In all instances of conscious recognition, however, it must be remembered that the *mental act* of explicit recognition is something unique; something which is not simply synonymous with the accompanying conditions which we have been describing. When we get these accompanying conditions we get the act too, and when they are all absent, the act is apparently absent. But the mental relating of the present idea, or perception, to the past as familiar is something distinctly additional to and beyond these concomitants.

On the physiological side it seems probable that ideational recognition is much like sensory recognition, save as regards the neural processes which initiate it. The sense organ activity is clearly not the immediate predecessor of the cortical action underlying recognition in the case of its ideational form. But the motor response is essentially identical, and its cortical basis may be, for all we can see, of a similar character. The matter can be put diagrammatically, as in the accompanying figure (60). In the case of sensory recogni-

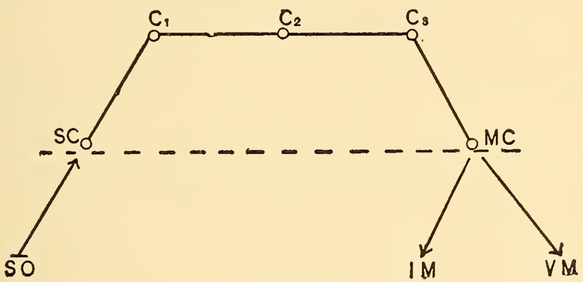

Fig. 60.

tion the process starts in the sense organ (SO) and is transmitted to the sensory regions of the cortex (SC), arousing perception. Thence it is transmitted, either directly to the motor centre (MC) and thus perhaps initiates movements of the recognitive sort, or it is transferred to other cortical centres (C_1, C_2, etc.), resulting in the arousal of supplementary ideas, which serve to give the perception its place in past experience, and the process is then carried over to the motor regions (MC), and thus out into the voluntary and involuntary muscles, producing the habitual response in completion of the sensory-motor cycle. In ideational recognition the process is of the same character, save that now the sense organ origin of the cortical excitation is lacking. The process starts, so far as we can discern, in some cortical centre like C_1. At all events, if a sensory process is really responsible for the result, it lies so far back in the series of cortical activities that we cannot confidently connect it with the result. It ought not to be necessary to point out again that the actual motor reactions characterising these processes of recognition may be of an extremely rudimentary and fragmentary kind. But the tendency to make the movements, with its indication of a degree of innervation in the motor cortex, seems to be a genuine part of the act.

Remembering and Forgetting.—It has already been abundantly emphasised that memory (using the term from this point on to the end of the chapter in the broader sense of common parlance, as equivalent to *recollection* in its various forms) depends in the last analysis upon the retentiveness of the nervous tissues. When we are not occupied with a thought, or an image, so far as we know, the thought, or image, simply goes out, ceases to exist. Certain psychologists prefer to think of these psychological facts as stored up in the mind in the form of what they call "psychical dispositions," or tendencies. But however it may fare with this last mentioned theory, the modifications of the cortical tissues which our experiences bring about are certainly relatively durable; and when the cortex is called upon to resuscitate a previous experience, it summons the appropriate centres, with their imbedded modifications, to perform again the action previously executed. This is apparently the physical basis of imagination and memory. In one sense, therefore, it is probable that no item of our lives is ever literally and entirely forgotten. Even if we find it impossible, as we sometimes do, voluntarily to recall a certain idea, we must believe that the experience in which we originally encountered it has left its indelible impress upon the substance of the brain, whose action will in consequence be somewhat different from that which it might have manifested had the experience in question never befallen us.

Despite this belief, forgetfulness is a constant and often exasperating characteristic of daily life. It also has a useful function, which we do not always recognise. From the psychophysical point of view we obtained the most important explanation of the value of forgetting when we were examining the facts about attention. In the chapter devoted to attention we found that consciousness is seemingly never impartial in its response to the objects presented to it. It is always primarily concerned with some particular portion of the objective field. It neglects this and attends to that, it is dimly aware of this and keenly cognisant of that. Now, if memory is dependent upon the modifications which neural stimulations impress upon the cerebral cortex, and if consciousness and cortical action run parallel with one another, as we have seen is apparently the case, it holds to reason that those items in any experience which procure our undivided and concentrated attention must succeed in leaving deeper and more permanent traces in the cortical tissues than do those to which we attend in the margin of consciousness, or than those over which we pass uninterestedly. Although the undoubted tendency of the brain is to register and store up all the impressions which are imposed upon it, the gradual change of organic structures must inevitably bring it about that some of the less deeply engraved modifications should gradually become so faint and so disused as to render them practically inert and incompetent to participate vitally in the operations of memory. Temporary functional disconnections of brain centres that normally are connected are familiar to all of us. I know my friend's middle name perfectly well, and yet when asked for it a moment ago, I could not command it. Some momentary stoppage of the associated pathways in the cortex checked the attempt at recall. Many of the most serious disorders of insanity involve this kind of disconnection and disintegration among ideas, of course much exaggerated.

One primary reason for our forgetfulness, therefore, is found in the process of attention. We must expect to forget a goodly part of all those items of experience to which we do not lend a vigorous and forceful attention. The only compensation for the lack of such concentration is found in the tedious process of repetition, by means of which we may, with even indifferent attention, grind gradually into our brain tissues any material which we desire to retain.

Forgetting has its use, however, in freeing us from the incubus of much utterly valueless experience. On the whole we remember fairly well those things which are of practical importance to us. Were our minds so organised as to retain with impartial accuracy all the events in our experience, and were their total capacity to remain unchanged, we should find our intellectual possibilities immensely curtailed by the obtrusion of the insignificant and irrelevant. While we are occasionally incommoded by forgetting, it is undoubtedly on the whole an added source of efficiency in our mental operations, that we find the unimportant elements of our knowledge so frequently dropping out of our memories.

Defects and Abnormalities in Recollection: A. Familiar Phenomena.—We obtain an interesting side-light upon normal memory processes by observing some of the common defects and abnormalities to which it is subject. These are in the main exaggerations of common and familiar deficiencies. Thus, in one form of mental disorder everything is forgotten the moment it passes out of the range of perception. We observe in ourselves the counterpart of this case, when after reading a sentence, for instance, we find, as occasionally occurs to all of us, that for a few moments we are absolutely unable to remember anything about it, and often must ignominiously read it again. The opposite type of abnormality is met with in the form of vastly heightened sensitivity to impressions, which can then be recalled with marvellous accuracy and detail. The mathematical prodigies who can recall lists of a hundred or more figures after a single glance are cases in point. Idiots sometimes possess astonishing verbatim memories of the same kind. With most of us the only phenomenon closely corresponding to this is found in our ability to recall experiences which have been characterised by intense emotional disturbance. The details of some episode in which we have been greatly terrified may linger in our memories with a vividness which rivals the distinctness of the original experience. Again, the memory of events during a grave illness may be almost wholly lost. A similar obliviscence as to the occurrences preceding a severe accident is very frequent.

There are numerous abnormalities in which the order of remembered events and the time of their occurrence is distorted; things are persistently "remembered," which never occurred, and imaginary events are interpolated among real events, in a manner which baffles analysis. The counterparts of these last named defects in our own every-day life and in the case of children will suggest themselves at once.

A simple experiment can be readily performed to illustrate these errors. If a series of numbers containing seven or eight digits be read aloud to a group of people and they be asked to write down at the completion of the reading of each series the numbers as they remember them, it will be found that three characteristic forms of error are made. (1) Digits will be given in an order different from that in which they were read. (2) Certain digits will be left out entirely. (3) Digits which were not read at all will be inserted in place of some which were given.

B. Diseases of Memory.—An interesting disease of memory which furnishes striking confirmation of our conclusions concerning the dependence of memory and imagination upon the image, consists in the loss of memory for specific forms of sensory material. Thus, the visual memory may be entirely lost, so that one cannot recall how objects look. Or the auditory images of words may be obliterated. If the imagery which is lost be of the variety chiefly employed by the patient in his thinking, the result is inevitably most disastrous, reducing the victim to a condition bordering upon imbecility.

General amnesia (loss of memory), which may arise from some severe shock, or may be found in dementia, as in the case of the very aged, involves a total loss of memory of all kinds, for events of the preceding moment as well as for remoter events. Partial amnesias are found which may either involve a limited portion of time, as when a person is unable to remember anything that occurred on the occasion of a severe accident, or it may involve some special sensory process, as in the cases mentioned in the preceding paragraph; or it may involve certain subjects only as in cases of forgetting a foreign language. In somnambulistic states events can be recalled which occurred in previous somnambulisms, but which in the interim have been entirely forgotten. A similar condition is sometimes met with in hypnotic sleep. The profound disturbances of personality met with in certain cases of hysteria are related by Janet to fundamental cleavages in the memory processes, by virtue of which one set of experiences gets entirely severed from the rest of experience and serves as the focus for the establishment of a new personality. We shall refer to these cases of multiple personality later in the book. Meantime facts such as we have just rehearsed show clearly how complex an affair memory is and how basal it is for all our important human interests.

C. Disintegration of Memory in Old Age.—When memory begins to decay under the advance of age there is a remarkable uniformity in the order in which certain kinds of knowledge disappear, and in many cases of insanity a similar order of disintegration is observed. Thus, the memory of proper names is among the earliest of the losses, and the more concrete are our ideas, the earlier do we lose the memory of the words for them. Abstract ideas which depend very largely for their existence in our thought upon the words which we use to designate them are by virtue of the law of habit much more persistent; because the word is in this case bound up much more widely and intimately with our use of the idea. So it comes about that the memory of adjectives and verbs, conjunctions and prepositions, outlives that of most nouns and proper names. The objects for which nouns are our verbal symbols we can, and frequently do, think of in terms of imagery other than that of words, *e. g.,* visual, tactual, etc. Consequently the memory of these words is less deeply imbedded in the brain tissues, and when this tissue decays such memories are the first to suffer extinction.

It is a familiar fact too that old people are much more forgetful of recent occurrences than of those which happened further back in the past. This is no doubt attributable to the loss of normal receptivity by the brain. It retains fairly well impressions made upon it at an earlier period, but it cannot now take on new ones.

D. An Illusion of Memory.—Another curious disturbance of memory, with which most of us are familiar, is found in the experience of an impression that we have previously been in the place where we are at the moment, or a conviction that we have previously said the words we are now saying, while as a matter of fact we know that we cannot possibly have been in the given situation, nor have spoken the words. Many explanations have been advanced for this phenomenon, which still remains, however, obscure as to its origin. It probably arises from different causes at different times, and is, perhaps, most often to be regarded as primarily a disturbance of emotional processes connected with the 'familiarity feeling.' It is in that case a kind of emotional illusion in which the organic reaction normally elicited by familiar situations is vigorously stimulated by some inappropriate object.

Individual Differences in Memory.—Common observation as well as careful experimentation indicates the widest variation among people as to the materials which they employ in their memory processes and also as to the proficiency which they display in acquiring and retaining information. Without attempting a complete survey of these differences, we may at least mention certain characteristic ones. We have hitherto commented upon the preferences which given persons evince for definite forms of imagery as compared with other forms. This need not be repeated, although it evidently will appear in the memory activities. Certain people can remember much better things which they see than they can things which they hear and *vice versa*. The basis of these preferences as to the source from which information is obtained in most cases can only be inferred with uncertainty. Apart from the question of the preference for a special sense or a special form of imagery in the exercise of memory, we find that certain people can learn very quickly but cannot retain long what they learn. Others can acquire only very slowly, but they retain firmly what they get. Others less fortunate than either class, can neither learn quickly nor retain effectively the information they try to obtain. A few favoured persons learn with great quickness and retain what they get with a tenacity and permanence which is utterly exasperating to the ordinary plodder. We shall discover some of the grounds for differences of the kind last mentioned when we discuss the training of memory.

Now and then a remarkable individual is discovered who altogether out-strips in some special direction the memory capacities of the average man. Some chess players have memories of this kind, enabling them to play while blindfolded a dozen or twenty games at once. Similarly the ability to remember page after page of numbers is met with, and this too after but a single reading or hearing. Musicians have occasionally remembered from a single hearing long and complicated scores. It is somewhat comforting to the common-place person to know that these prodigies are ordinarily no better than, and often quite inferior to, the average individual in all other uses of their memories save the one which gives them notoriety.

Training and Development of Memory Processes.—A good memory, in the practical sense of the phrase, would seem to depend upon (1) ease and rapidity of acquirement, (2) permanency of retention, and (3) the ability to recall information promptly and accurately when wanted. These results clearly involve (a) the *original act of impression,* (b) the process of *retention,* and (c) the *act* of *recollection.* The original impression and the act of recollection are under our immediate control. The process of retention, once a stimulation is given, depends upon the brain tissues, whose condition we can improve only indirectly by giving ourselves healthful habits and hygienic surroundings. In the interests of brevity no effort will be made to treat separately these three factors in efficient memory activities. The reader, who desires so to do, can easily assign the facts canvassed to their appropriate compartments.

A. Repetition, Vividness, Recency, and Number of Associations.—It is evident that any effort to train the memory must, if it is to succeed, be based upon the employment of such principles as are natural and inherent in the memory process itself. Now one of these principles primarily concerns repetition and involves factors which are largely mechanical in their nature. If the cortical basis of retention is resident in the modifications of nervous tissue, brought about by the impressions which pour in upon us, it is clear that anything which will augment the permanency of these modifications, or increase their number, will in so far make towards the preservation of the accompanying psychical processes and the establishment of an efficient memory. Experience certainly justifies this statement, for we find that any impressions which we can make extremely vivid are likely to be retained in memory for a longer time than would be the case if the impressions were less intense. Such vivid experiences are always productive of deep-seated neural excitement, and we may reasonably suppose that their ready retention and recall is a sign of the depth of the nervous modification produced by them. Similarly, the mere repetition of an impression must serve sooner or later to set up relatively permanent modifications in the brain tissue, and so indirectly accomplish permanency of retention in the mind. Temporary effects can be produced, as every schoolboy knows, through the influence of *recency* of stimulation. Cramming for examinations, when successful, rests largely on this foundation. These points, together with the others mentioned in this section, have, with a single exception, been already touched upon in our account of association in the previous chapter.

It is not often easy in a practical way to enhance the effectiveness of our memories through rendering *emotionally* vivid the impressions we wish to preserve. But so far as we can succeed in *focalising our attention exclusively* upon the matter in hand, so far we do make gains in vividness, and the importance for efficient memory processes of concentrated attention is based precisely upon this fact. Speaking from an empirical point of view, it seems probable that the immense variation in the memory processes of different people is largely connected with this difference in ability to concentrate attention. The habit of giving oneself with complete abandon to the undertaking immediately in hand is one of the most significant clues to the securing of an alert and accurate memory. Moreover, this concentration of attention is as significant at the time of *recall* as it is at the moment of original *impression*.

Obviously it is simple enough to make use of repetition. We may either do this by giving ourselves over and over again the same sense stimulation, as when we repeat a name which we wish to remember; or we may, after the manner of the modern elementary schools, present the same object to a *number of different senses,* as when we listen to the sound of the name, then speak it, then write it and look at the written word. In such ways we can increase the *depth* of the cortical modifications, corresponding to some single sense department, or we can increase the *number* of cortical areas affected by the stimulus. In either case we evidently increase the total amount of cortical modifications, and so better the chances, not only for permanent retention, but also for easy and ready recall. The more pathways there are in the brain leading to the stimulation of any special activity, the more likely is it that the given activity can be promptly aroused. The more ideas there are in the mind connected with any given idea, the more chances there are for the expeditious production of the latter when needed.

As a matter of fact all memory processes depend in some measure upon this mechanical factor, but it becomes relatively less important as the general level of intellectual development rises. There are many things which children must necessarily get at first in a largely mechanical fashion. Learning to spell, for example, is in English mainly a mechanical accomplishment, the available rational elements being chiefly conspicuous by their absence. But for adult undertakings it is a poor memory which responds only to mechanical incitements. Nevertheless, our modern education, with its extensive desertion of all verbatim methods of memorising, is undoubtedly in danger of pouring the baby out with the bath, of discarding a method useful in its place, even though not useful in all places.

B. Logical Method of Memorising.—The most important factor in assisting the establishment of broad and effective memory processes is of a practical and logical character. If we can once knit up a fact to be remembered with a group of other already known facts with which it is intimately related, we often come to see the members of the entire group as mutually dependent upon, or explanatory of, one another. And thus we find we can retain in memory the total mass more efficiently than we could a much smaller number of items, so long as they remain unrelated. Such an interrelating of the facts has in a sense the effect of reducing the mass to a *single mental* fact. A child being taught the method of long division in arithmetic, or the method of determining the square root of a number, finds the successive steps in the process extremely difficult to keep straight, so long as the procedure is based simply upon the memory of the rule, which states dogmatically the order of the various operations to be performed. But as soon as the relation of the several steps to one another is clearly apprehended, as soon as the real nature of the process is understood, the verbatim memory of the rule becomes a superfluity, which may be forgotten with entire impunity. The several facts represented by the separate arithmetical operations all flow together as integral parts of a larger whole, to which they are seen to be essential. Thereafter, the nightmare of a forgotten rule is banished. In a certain sense, however, the rule can hardly be forgotten as long as the clear apprehension of the relations involved remains. For the rule is simply the verbal formulation of these relations. But under such conditions one's action is free, intelligent, and independent, instead of blind and slavish to a mere rule-of-thumb.

If we are asked how to go about the creation of these logical relations among the facts with which we wish to equip our memories, the answer will turn upon two points. We must first reflect upon the thing to be remembered, and attempt to give it a setting among the things with which it is most closely connected. No fact ever comes to us wholly isolated from the rest of our knowledge, and most facts bear upon their faces evidence of their most intimate relations. We should at once, then, scrutinise each new fact that comes, and inquire what there is in the series of events or relations to which it belongs that has occasioned its existence. We should ask for the causes which have produced it, and the consequences to which it leads. If we can succeed in setting up relationships of this kind, we find that the new fact becomes a real part of our minds, just as in the case of the arithmetical rules of which we spoke a moment ago. In studying history, for example, such a procedure will mean that we shall try to see any given fact, like a battle, a cession of territory, or a piece of legislation, in the light of all the facts, political, social, economic, geographical, etc., which may bear upon it in any significant way. All the important episodes in an historical period will thus be welded together, each throwing light upon the other in a way which makes it natural and easy to recall them.

An ideally perfect mind would involve, among other things, a complete working out of all the relations sustained by a given fact to all other known facts. In actual experience, however, we find that our information is largely stored away on the compartment principle. Our knowledge of history seldom gets any very intimate articulation with our knowledge of astronomy. The events with which each deals do not appeal to us as intrinsically germane. Similarly, our knowledge of exact science seldom interferes in either a theoretical or a practical way with our knowledge of politics; and it is notorious that, for certain persons at least, religious knowledge and belief are kept quite distinct from every other intellectual and practical interest.

In the second place, we should always, when possible, proceed at once to make some actual use of the information we are seeking to impress upon our memories. In a certain way the process of reflection, which we have just been describing, necessitates our using the facts we are trying to memorise. But we have in mind here a more overt activity. We saw in the previous chapter that the fundamental function of our memory and imagination is the control which they afford over experience, both past and future. These activities are, moreover, only a sort of half-way house between the sensory stimulus and the motor reaction, of which we have heard so much. The relevant motor expression ought, therefore, to be allowed to occur. If all this be true, we shall have some theoretical foundation for the precept we have just formulated, a precept which is abundantly justified by experience. The sooner and oftener we can apply to some practical undertaking a fact we wish to remember, the better the chance of its remaining in our minds. Talking about it, writing about it, incorporating it into some manual constructive activity, if it is a fact which will permit such treatment, are all methods of accomplishing the desired result. A mind trained to concentrated logical reflection upon facts, and then further trained to make the earliest feasible application of them in practical ways, is a mind which will achieve the maximal efficiency of which it is capable. Ease and rapidity of acquirement, promptness in recall on demand, and permanency of retention will all be at their best.

C. **Mnemonic Systems.**—Evidently these methods of training the powers of retention and recall suggest no easy royal road to success. They mean hard work. But they are the only methods which have any large and general significance for the development of the mind. Many catch-penny devices have been hit upon to simplify memorising, and within certain narrow limits such systems have a value. The mnemonic schemes of many so-called "memory systems" illustrate the point. Suppose one has occasion to remember a great many unrelated numbers, like the street addresses of a large group of people. One may greatly facilitate such a feat by first memorising a "form," in which each digit is connected with a consonant, *e. g.*, the 1 with t, 2 with l, 3 with d, etc. The next step is to make a word easily suggested by the person whose house number is to be remembered, in which these letters shall occur in proper order. For example, Mr. Smith's number is 122, Mr. Smith is tall. The word tall in the number form means 122, for the vowels are neglected. For special purposes, such as that of our illustration, such methods can be made very useful. But as applied to the acquirement and retention of miscellaneous information they are failures. It requires more time and effort to learn the forms, or frames, and then make the applications, than is required to accomplish the same result in the ways we have already pointed out.

Idiosyncracies in Form of Recall.—Many persons have curious individual peculiarities in their methods of recalling specific kinds of material. Thus, certain people always think

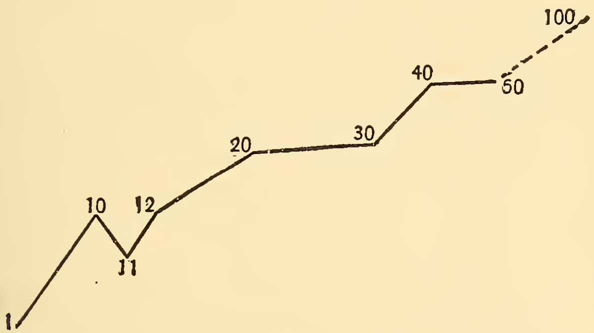

Fig. 61. In this form the numbers are seen extending upward and to the right from about the level of the shoulders.

of the numerals by means of a kind of visual framework, known as a number form. These number forms are most various in their shape and size and general character, some of them being seen as coloured in many hues. An example of one of the simpler types is given in the accompanying sketch. (Figure 61.) A person possessing one of these forms always sees the numbers about which he is thinking appearing in their appropriate place in the framework. Other persons always think of the months of the year, the days of the week, and even the hours of the day, in similar visual frameworks. All these devices seem to represent the effort of the mind to give a concrete basis to abstract relations. But they are for the most part acquired in early childhood in a perfectly naïve way, and apparently indicate native differences in the way different minds get hold of material to be remembered. "Coloured hearing," or chromæsthesia, of which mention was made in the analysis of perception, belongs to the same range of individual idiosyncrasy.

CHAPTER X

THE CONSCIOUSNESS OF MEANING AND THE FORMATION OF CONCEPTS

In the actual execution of the functions hitherto described another mental operation is involved in addition to those which we have thus far analysed. This operation is contained in a latent fashion in each of these conscious activities with which we have been dealing; but it comes repeatedly to light as a relatively distinct mental process, and we must accordingly submit it to examination. Indeed, many of the acts which we have used as illustrations throughout our previous study could hardly result as they do were it not for the presence of this mental factor, which is known in its most developed form as *conception.* The mental product which results from it is called a concept. In its more rudimentary form we may call it the consciousness of meaning, and we shall discuss the simpler phase first.

The Consciousness of Meaning.—On the side of function, the most fundamental property of intelligence is, perhaps, the ability to recognise and employ *meanings.* Perception could never lead to the establishment of efficient habitual coördinations were we not able to apprehend the meaning of that which we see and hear and touch. Memory would be an abortive resuscitation of the past could we not recognise the meaning of that which we recall. Imagination in all its forms would be a mere mental logomachy were it not for our ability to understand the meaning of the images which occupy our minds. We shall later see that volition, or conation, depends from the very first on the use of meanings. From the beginning to the end, therefore, of our mental activities the presence of meaning is absolutely indispensable.

That a thing means something to us is equivalent to saying that it symbolises something for us, that we are aware of some of the relations which it sustains to other things. Now, the mind shows itself from the very outset as a relating activity. We have previously analysed one of the most elementary forms of this relating process in our account of recognition. On the level of perceptual and sensory activities the crude, vague identifying of one experience with an antecedent one must represent in the infant consciousness the first outcropping in an explicit way of the relational factor, the first appearance of the awareness of meaning. An experience which is recognised, no matter how vaguely, is thereby in our very manner of feeling it connected by us with something else not present.

Meaning in Sensory Material.—The manipulation of the sensuous material of experience—now in an analytical, discriminative way, and now in a synthesising, associative way—results inevitably from the very first in the disclosure of innumerable relations involved among masses previously sensed in a rude, inchoate manner. Certain typical forms under which this analytic-synthetic development of relations occurs, we have already described in the chapter on attention, so that we need not repeat the matter at this point. We are emphasising here, however, as we did not do at that juncture, the fact that our noticing of differences and likenesses in the material presented to our senses rests upon our ability to note and employ the relations which these processes of attention throw into relief. It is, in short, because the elements which we thus break out from the total mass of unanalysed sense experience possess meaning for us, symbolise relations of one and another kind, that we can employ them coherently and efficiently. Without this element of apprehended meaning they would remain disconnected, wholly irrational and inert bits of mentality; curious perhaps, but certainly useless. The element of meaning joins them to one another in a vital organic union.

Pure sensation can be thought of as bare material wholly devoid of meaning, a mere "that"; and we can similarly conceive of sheer meaning disconnected from all imagery or sensory stuff. In actual experience we never meet either condition. Sensations always have some meaning however rudimentary, and meaning is always draped upon some carrier, whether image or sense process. This statement is certainly true of all strictly conscious activities. Whether rational processes may occur by means of sub-conscious cerebral action and without conscious manifestations is quite another question.

Probably the most fundamental form of this consciousness of meaning and relation is our previously mentioned awareness of sameness and difference. We know at once without tutelage of any kind when two experiences seem to us the same, and when they seem different. Evidently, the process of recognition is closely related to this sense of sameness, if it be not, indeed, found practically identical.

Meaning in Ideational Processes.—All that we have said, thus far, about sense perception and the analytic-synthetic play of attention upon such material is true in even more obvious fashion, when we come to speak of images and ideas. The idea is, as such, clearly a symbolic affair, finding its *raison d'être* not in itself, but in that which it does, that for which it stands. Evidently *meaning* is the very essence of the idea. Moreover, we develop the meanings and relations among our ideas by means of just the same kind of attention processes as characterised our manipulation of sensory activities. By focussing our attention now upon one feature of a thought, and now upon another, by "abstracting," as it is sometimes called, one phase or another, we analyse our ideas, compare them with one another, and so come to the discernment of unsuspected relations, of unrealised likenesses and differences.

Psychological Basis of Meaning.—Psychologists are by no means agreed as to the precise nature of the mental activity by means of which we apprehend relations. Certain writers make the whole achievement a function of attention, and disclaim the necessity for any further explanation. Attention is declared to be in its very essence a relating activity, and consequently, so far as we attend, we always attend in a relational way. Other writers maintain that just as certain moments of consciousness are cognisant of percepts or images, so certain other moments are cognisant of relations. Thus James speaks of our having "feelings of relation," *e. g.*, a feeling of "and," a feeling of "if," and a feeling of "for." Certain psychologists of this way of thinking recognise what they call "relational elements" of consciousness comparable with sensation elements.

A complete consideration of this matter would take us too far afield into unsettled principles, and the reader must temporarily countenance the author's dogmatic general statement that the consciousness of relation is a basal factor in all activities of attention; that our attention is sometimes more, and sometimes less, directed toward the extant *relations* than toward the *things* related; but that no moment of cognitive consciousness is wholly lacking in the awareness either of relations or objects. The distinction between objects and relations simply names two features, the static and the dynamic, of a common phenomenon. The relational processes are perhaps best characterised as attitudes. The mind is in a different condition of expectancy after hearing the word "and," from that which it manifests after hearing the word "if." These differcnces are no doubt often reflected in different *overt* motor acts and perhaps always by different *nascent* ones. Some of these motor expressions will be found appearing in the checking and releasing of the breath, as anyone may verify for himself.

We come next to consider conception, which constitutes the most overt and elaborate form assumed by our consciousness of meaning, a form in which psychologists and philosophers have always been specially interested.

The Nature of Conception.—In our illustrations of the manner in which we consciously avail ourselves of the lessons taught us by experience, we have implied that memory and imagination operate by summoning specific events which apply to the problem immediately confronting us. This is often the case. Thus, I find myself puzzled as to the best method for getting to some very remote country town. I attempt to recall what railroads I employed to get there a year ago, and I solve my problem by applying the recollection which comes to me of this particular achievement. I remember that I took the A and B to junction D, waited two hours and got a train on the X and Y to my destination. But many cases in which we apply the fruits of past experience are of a different order from this. Thus, if I am purchasing scientific instruments from a French firm, I must convert the prices in their catalogue from francs into dollars. This I accomplish by first bringing to mind my idea of a franc, as being approximately a fifth of a dollar, and then performing the appropriate arithmetical operation. In this case I obviously employ my memory in meeting my necessities; but it is memory in the form of reproductive imagination upon which I fall back, and not necessarily the memory of any *single* event or experience, as in the preceding instance. Again, I am interested in certain philanthropic efforts at social reform, and I find that the programme which I am invited to support involves belief in the hereditary nature of acquired characteristics. The theory at issue maintains that vicious traits are acquired and transmitted from parents to children, and my contribution is solicited in the furtherance of a project to prevent the possibility of such acquirement and transmission. Immediately I find my mind busying itself with the idea of heredity, and my final action is, perhaps, determined by the conclusion which I am able to reach upon this point.

Now in these last two cases my use of the idea of a franc or my idea of heredity clearly does not necessarily involve an immediate reference to any single and specific experience of francs or heredity. I might, of course, make the application in this way, if I chose. I might allow my mind to dwell on the last occasion upon which I saw a franc, and on the last book in which I had read of heredity. But this is by no means essential, and often would not occur under such circumstances as we have supposed. Accordingly, these ideas, to wit, franc and heredity, are mental devices by which we succeed in symbolising for ourselves in the one case a number of objects, and in the other case a number of relations, without the necessity of calling to mind any particular occasion upon which we have come in contact with them. We use these ideas fearlessly in our reasoning, and when we have reached our conclusions we make the application to the concrete instance in hand, with entire confidence that the event will justify our action—and generally it does. Such ideas as these are what are usually called concepts, and taking such cases for the moment as reliable illustrations, we may say, following the common usage, that *conception is that mental operation by means of which we bring together the common points of our various experiences and mentally consolidate them into ideas; ideas which we are then able to use as symbols, or representatives, of these manifold items.* We apply the term "concept" to this idea, the term "conception" to the mental operation in which the idea is produced. The derivation of the word concept (from *concipere,* to take in) may assist us to bear the facts in mind.

If concepts are general ideas of the kind we have indicated, it is evident that we must possess them in large numbers. Concepts of men and horses, houses and trees, hats and tables, with others of like ilk, must constitute a large part of our mental furniture. We must also have concepts of such things as colour, odour, and sound; concepts of physical relations, like position, order, and time; concepts of moral attributes, such as good and evil, and dozens of other forms too numerous to mention. We shall probably get ahead most rapidly in our analysis if we take some special instance of conception and examine the mental processes involved in it. Take in this way one's general idea of horse.

Concept and Image.—If I say to a group of persons, "Fix your attention firmly upon your idea of horse," a certain number of them are sure to find a visual image of a horse arising in their minds. Another group will find that the auditory-motor word-image "horse" is present in their consciousness. Now, according to our definition, the concept of horse must not apply to any special horse, but it must represent all horses. How can the persons who are confronted with a visual image of some particular Bucephalus, or Rosinante, be said to have any concept of horses in general? The correct answer to this question is at once suggested by a reference to the imagery of the second group of persons.

The word-image "horse" evidently does not pretend to refer to any one specimen of the horse more than to another. It is purely symbolic. When it comes into our consciousness to serve as a concept, it is as though we had agreed mentally with ourselves to accept it as a representative of the physical equine genus. Just as in algebra we allow the early letters of the alphabet to stand for certain quantities in our problems and the later letters for certain others, making the appropriate practical substitutions at the completion of our computation, so here we symbolise certain objects to ourselves by means of auditory word-images. We mentally manipulate these image-ideas, draw certain inferences and then execute the substitutions, which in these cases are commonly overt acts. Having, for example, reflected by means of such concepts upon the shortcomings of horses, we decide to purchase an automobile. The concept, which is primarily *mental,* is eventually converted into movements which are physical.

Now, the case of the persons who use visual images is in no respect fundamentally different from that of these users of word imagery. The visual image may, to be sure, for better or for worse, be a kind of *copy* of an *individual* in the class which it is supposed to represent. At least it is often a recognisable copy of one of our perceptions of such an individual. But provided that, in our use of an image, we recognise it as *really* symbolising the *class,* and not an individual, and use it *intending* it to accomplish this purpose for us, it is a matter of considerable indifference what special kind of imagery we happen to employ, whether visual, or auditory, or motor. Of course word images are freer from the possibility of suggesting misleading concrete details than images of other varieties. But even they may be vitiated by erroneous implications of one or another kind.

We shall now and then meet persons who will insist that their idea of horse does not involve any detectable imagery of any kind. They "just know" what horse means and that is all there is to it. People of this type represent several forms of reaction. In many instances this report is due solely to introspective obtuseness and lack of practice in detecting mental processes. With some the imagery is of a fleeting vocal-word character which they readily overlook. With certain ones there may be a suppressed pronunciation of the word and beyond this they employ no thought machinery at all. In a few cases there exists a very subtle form of motor imagery, or even overt movement itself may be used. The nascent movements, or images of movement, may be connected with the conceived object in any way whatever. They may, for example, be tracery movements of hand or eye. Anything to which the meaning "horse" can be attached will serve.

Two important points emerge from the preceding examination. (1) The concept normally involves an image, whether concrete, verbal, motor, or what not. A substitute for the image in the form of nascent movement may possibly be employed at times; (2) Whatever image we use, it is the *specific meaning* which we attach to it that constitutes it a concept. These two considerations make clear how it comes about that our thought processes seem often so different on different occasions, even when we have been thinking about the same subject. Of course, the order of our thoughts might easily vary at different times, and our conclusions might vary. But how is it that we can think about the *same* things when the *content* of our thought is so different? The content of our thought is, so far at least as concerns the knowledge process, largely made up of imagery. To-day this may be principally auditory and verbal, to-morrow largely visual. It may be on the one occasion vivid and detailed, on the other evanescent and wholly schematic. But provided I use the different images to stand for the same meanings on the two days, I shall come out perfectly well and my thought will unquestionably have been about the *same* object and its relations. Thus it comes to pass that, although we never have literally the same image present twice in our consciousness, we nevertheless can think the same meaning again and again.

The Generic Idea.—This seems the appropriate place to refer to a theory which certain eminent psychologists have espoused, *i. e.,* the theory of generic ideas. The hypothesis upon which the theory rests is that our repeated visual perceptual experiences of tables, for example, result in producing a kind of composite mental photograph of tables. Such a composite photograph would evidently serve us whenever we wished to think of tables in general; that is to say, it would serve as a concept. We might use other images for the same purpose, conspicuously our word-images; but we might equally well use this composite visual image. It is held, therefore, that the generic image is a sort of embryonic concept, more concrete than the true concept, but less concrete than the images of particular objects; in short, a transition form.

We shall make only two comments upon this theory. In the first place it is extremely difficult to determine whether or not we really have such composite images. It would obviously be very difficult to say with entire confidence whether an image possessing the indefiniteness of outline and the indistinctness of detail which a true composite would undoubtedly possess, were actually a representative of innumerable individual perceptions; or simply a blurred, vague, imperfectly reinstated image of some single perception. Introspectively, that is to say, the evidence can hardly be made conclusive in support of the theory. Moreover, the brain processes involved in the production of such an image are somewhat difficult to understand when brought into connection with our supposed ability to call up images of specific objects belonging to a given class, of which we might also have a generic image. However, there is perhaps nothing impossible about the theory.

In the second place, so far as concerns the function of conception, it appears at once that such a generic image would belong to the class of images which we may call "copy-images," in distinction from images which purport to be *merely* symbols. All images, are, of course, symbolic, so far as they stand for something not themselves, and all images are copy-images so far as they serve to reinstate special forms of sense perception. An auditory image may be in this way a copy, good, bad, or indifferent, of an acoustical perception. A visual image may likewise simulate some visual perception. But the auditory image may, on the other hand, serve to symbolise some visual experience, and the visual image, *e. g.*, the visual image of a word, may also symbolise something of a non-visual character. Evidently, copy-images may be hopelessly inadequate, *as copies,* to stand for generalised relations. So, to revert to our original illustration, a visual image of a table would, as a mere copy, be an unsatisfactory representative of the class "table," for no single image could embody all the peculiarities of all tables. This limitation would be as true of the composite image, supposing it to exist, as of any other. It is only as such an image is employed symbolically that it serves satisfactorily as a concept of the class "table." But an image of any table whatever would serve this purpose well enough, provided only that in our thinking we used it with this recognised intention. Furthermore, the word-image, which commonly has no resemblance whatever to the objects symbolised, is always available. So that taking account of these considerations—the doubt as to the actuality of the generic image, and the absence of any special fitness in it for service as the basis of a concept—we may safely omit further discussion of it.

Conception and Language.—Our analysis of conception has brought out the fact that it is by means of this mental process that we are able to make our thoughts the vehicles of definite meanings. It is a familiar fact that language has a precisely similar function. The inference at once suggests itself that language may be nothing but an elaborate conceptual system, and this inference is essentially correct. When we communicate with others we give our ideas outward expression in spoken words, which serve as concepts to the hearer. When we are engaged in reflective thought, we shall often find that we are thinking in terms of word-images, and these word-images in such cases serve as our concepts. Language is thus not only the great *social* medium of thought exchange, it is also in large measure the medium of subjective thought processes.

Some psychologists maintain that all concepts are of the language variety, and philosophers formerly contended that no reasoning would be possible without language. Both of these views are undoubtedly too extreme. We do sometimes reason, and we may have a considerable number of concepts, without resorting to verbal language. Nevertheless, the supplementary statement must be made that language is the great conceptual mechanism, and that we depend upon it far more than upon any other mental material for conveying our meaning, not only when we commune with others, but also in our own private thinking.

In the use of spoken language, as well as in the use of verbal images when we are reflecting, the thought process is often so rapid that we have no distinct consciousness of the words as such. The stress of our interest and attention is upon the meaning which we are seeking, and this seems often to attach to the verbal activity in its entirety as a sentence, or a series of sentences, rather than to the isolated words. This fact does not, however, prejudice the truth of our general assertion that words serve as our most important conceptual symbols.

Theories of the Origin of Language.—The origin of vocal language has been connected with a number of influences of which three may be mentioned. (1) Certain emotions lead instinctively to vocal expressions, *e. g.,* the cry of fear and the snarl of rage. In the animal world such expressions are effectively employed as a means of communicating mental states. The theory of the origin of language from such cries is ordinarily known as the 'interjectional.' (2) When cries of this kind and other natural sounds are *imitated to indicate to others* the object or condition which naturally produces them, *e.g.,* barking to convey the meaning 'dog,' we have language in a more genuine sense. The theory that language arises in this way is known as the 'onomatopoetic.' It may be more briefly styled the 'imitative.' This theory has been given certain very subtle elaborations into which we cannot go. Both the interjectional and the imitative theory emphasise presumably true stages or factors in the process of linguistic development. The first probably indicates correctly the source from which the material of language is drawn. The second designates one method at least by which this material gains real linguistic properties. (3) We may add the prescientific doctrine that language was given to man by direct act of Providence.

Vocal language is originally not different in character from visible gesture which is quite competent to convey meanings and has from the first been employed for this purpose, witness the practice of animals, primitive peoples, and deaf-mutes. Indeed, everybody uses such gestures to supplement the meaning of words. Among cultured peoples this is especially true of the Latin races. Like all concepts, one of the most useful functions of the developed word is to suggest attitudes without the necessity of filling in details of meaning with concrete material. Words still retain therefore their primitive connection with gesture and attitude.*

Language in Relation to Particular and General Ideas.—The conceptual use of language brings readily to our notice certain facts which bear significantly upon our present topic. We defined conception as a process of forming general ideas, and this seems to be the most striking feature in the process. But if words can be regarded as concepts, we must have concepts of individual objects as well as of classes; or at all events our method of thinking individual objects must be similar to our method of thinking classes. This is, indeed, the fact. We really have a concept of Jupiter, as well as of gods; a concept of earth, as well as a concept of planets; a concept of this particular book, as well as of books in general.

*The choice of vocal movements rather than some other form of movement to serve the language function has been connected with various causes. We know that excitement produces muscular changes. The respiratory muscles are especially easy to affect in this way, and in large air-breathing animals at least audible sounds are inevitable consequences of such disturbance. Moreover, the vocal cords have no other important function to be interfered with by their vocal use for language. Sound is better material than light, which is its only serious competitor, for use in direct communication, for it is more independent of constantly recurring conditions, *e. g.*, darkness and intervening objects. These and other similar reasons probably account for the adoption of vocal sounds for linguistic uses, although such selection may in the first instance have involved very little of conscious choice. (Cf Judd, Psychology.)

We have only to remember that conception is after all at bottom simply a mental process of *designating meanings,* to see that we can in this way indicate any meaning we wish; *e. g.,* the meaning of a single object or a dozen; the meaning of a mathematical relation, or of an historical relation; the meaning of a familiar object, or of an impossible one. In each and every case we shall have a concept, and in most cases a word, or a word-image, will be a very convenient device by means of which to think it.

We may easily connect the process by means of which we gain concepts of single objects with the process by means of which we obtain general ideas of classes of objects, if we observe that in both cases we have simply set a boundary line about certain things; in the one case the boundary contains one object, in the other it contains an indefinite number. But in both cases our mental act has been the distinguishing of one kind of meaning from all other kinds of meaning. That form of the process in which our idea refers to some common property, or properties, of a number of experiences, like hardness, or blackness, or goodness, has commonly been regarded as the true type of conception, because we appear in such cases to have *abstracted* the common qualities of a number of events, then *generalised* upon these, and so obtained the concept, or general idea. But the process by which we reach a concept of a single object involves abstraction just as truly, if not so extensively, as the previous form of operation. To obtain a concept of London involves setting the idea of London off against all other ideas; involves abstracting it in a perfectly definite way. In a sense, too, our concept of London is just as complete, just as universal, as is the concept city. It applies to *all* of its object, as truly as does the concept city, and it is in a measure an accident, an irrelevant incident, that the total object referred to is, from the practical point of view, singular and not plural.

The process by which we actually come into possession of some of our more abstract general ideas is, perhaps, more complicated than that by which we gain our concepts of particulars. But the fundamental distinction between the two kinds of concepts, after we have attained them, resides in the fact that the one emphasises points of *identity and sameness* among the various elements of our experience, the other emphasises primarily points of *difference.* Strictly speaking, then, we may be sure that we have concepts of single objects, as well as of classes of objects. We have, also, concepts of abstract attributes, concepts of relations of all kinds. There is no meaning of any sort accessible to our intelligence for which we may not have a concept. Indeed, in the broad sense of the term, every idea is a concept.

On the whole it is, perhaps, easier to follow the older usage and to retain our original provisional definition of the concept as a generalising idea, and then to remember that such ideas sometimes generalise, so to speak, upon single objects, qualities, or relations, rather than to recast our definition, which would then vary somewhat ambiguously from that traditionally employed. After all, the fundamental points about concepts are those we have already mentioned, which evidently remain untouched by these questions of the number and character of the objects to which the concepts refer: that is, (1) the existence of the concept as a concrete thought, which we call an image or idea; and (2) the use of this image-idea to convey to ourselves, or to others, some definite, recognised, and intended meaning.

Scientific Concepts.—It should, perhaps, be remarked at this point that the scientific and logical concept is generally credited with a higher degree of exactness and precision than our definition suggests. The concepts of science, such as "metal," are gotten by a process of abstraction and comparison, the result of which is then expressed in the most rigorously exact verbal definition. Evidently, however, these are not the concepts of practical life. Scientific concepts are outcomes of definitely reflective processes, whereas the concepts of daily life have many of them originated in the rough "give and take" of practical experience, without any explicitly reflective deliberation at all.

The General Function of Conception.—The general function and value of conception in the economy of the psychophysical organism is probably so obvious as to require no further elaboration. It may be described as the great simplifier of mental operations, the labour-saving device by means of which we are enabled to accomplish with single ideas the work which otherwise might require the coöperation of many. It only remains to call attention afresh to the fact that the mental capacity which permits this condensation of the meaning of many experiences into the meaning of a single image is generically one and the same with that apprehension of meaning which renders perception intelligible, imagination significant, and memory coherent.

Neural Process and Conception.—So far as conception involves imagery, it necessarily follows that it depends upon the reaction of those areas in the cerebral cortex with which the several sense organs are most immediately connected. Beyond this we can say very little, save that there seems some reason to believe that all the more reflective and ratiocinative forms of thought process involve in an important way the action of the Flechsig association centres. It must be frankly admitted that at the present moment the neural counterparts of these higher and more recondite phases of psychical activity are practically unknown. It seems clear that they must in large measure involve the action of the same areas that are concerned in perception and in simple acts of memory. But the nature of the differences in the form of the nervous action, when the psychical act is one of prolonged reasoning with the use of elaborate concepts, as contrasted with the mere accidental calling to consciousness of some familiar visual image, for example, is still altogether a matter of speculation and hypothesis.

The Genesis of Conception.—We have repeatedly seen reason to believe that mental life is in all essential respects like other life phenomena, manifesting periods of growth, maturity, and decay. This view leads us to expect a gradual unfolding of the typical phases of consciousness, which are at the outset latent in the infant mind, rather than the sudden appearance at different times of totally new kinds of mental operation. The development of conception is no exception to this rule.

The appearance of a rude type of recognition, which we have discovered to be the prototype of the developed act of conception, may be detected very early in infant consciousness. But it is exceedingly difficult, not to say impossible, confidently to designate the precise moment at which the first general idea is elaborated. The facts suggest that babies generalise in a rough way upon their experiences at a very early date. Or, if they do not positively generalise, they accomplish the same result negatively, by failing adequately to distinguish and analyse. Infants a few days old, if given some distasteful medicine, will often refuse utterly for hours afterward to take anything into their mouths, and for indefinite periods will reject the medicine itself. It would probably be absurd, however, to suppose that the baby has at this time a general idea of medicine, although one might with propriety speak of a *generalised motor reaction.* Nor would such a description detract from the genuinely conceptional nature of the reaction, for the *concepts of adults may also be considered as forms of generalised motor activity.* As soon as language appears, from the fourteenth to the twenty-eighth month, the formation and growth of general ideas is immensely augmented. But our previous assertion about the connection of concepts and language holds true here, and it is certainly reasonable to suppose that crude general ideas antedate the use of adult language forms. In this connection one must not forget that gestures—for example, smiling, scowling, clenching the hands, etc.—are often vehicles for conveying conceptual relations, and that the inarticulate cries and vocalisations of various kinds which precede the intelligent use of words may also be regarded as primitive linguistic concepts. Thus, a certain sound means water, another means milk, and so on. The sign language of deaf-mutes affords admirable illustrations of the same types of expression for concepts.

Incentives to Conceptual Development.—The natural incentive to conceptual development is to be found in the needs of the individual. We find ourselves confronted with a situation in which our old ideas are inadequate and unsatisfactory. These are the circumstances which lead children and adults alike to search for new ideas, for efficient concepts. New notions in science, new inventions, the slow growth of myth and many of the articles of religious faith have this origin, *i. e.,* the desire for concepts which will enable us to master a given difficulty, whether practical or theoretical. The development of the concept of number offers a good illustration of the process. Until life has become somewhat complex and organised, number is not needed. Generally in connection with the accumulation of property of some kind the need arises of counting one's possessions in order that loss may be easily detected. Among certain savages this necessity is met by a very small series of numbers and they consequently are unable to count beyond five or ten. In civilised life such a number system would be grotesquely inadequate and the higher numerical relations are demanded, together with the concept of number itself which we thus see has its origin in counting.

When we seek illustrations in the range of our formal educational procedure it is not always so clear that the new concepts are gained in response to felt deficiencies in our existing stock of ideas. The boy confronted with the concepts peculiar to the study of Greek and Latin and mathematics would often forego the attainment of them with definite complacency, not to say enthusiasm. It is evident that if he is to master these subjects he must first secure these concepts; but it would sometimes be a sad perversion of the facts to say that the concepts are obtained as the result of a need *felt* by the boy. A child caught thus in the educational machinery is often whirled about among needs, for which the ideas held out do indeed afford relief, but they are not always needs which the child himself feels. One has, however, only to glance at the history of any specific educational system to recognise that in its inception each system was intended to fit its pupils for some special form of life, and in this vocation the studies offered really had a place. The adult has here attempted to anticipate in the most effectual way the needs which at some time the child is sure to feel. Fortunate the child who is brought up in a system which affords him ideas fitted to his own day and generation, instead of those appropriate to the times and conditions of his great-grandparents.

The concepts which we get in the educational system may not always, then, reflect needs and difficulties of which we personally are as yet cognisant. But the system itself is an effort to epitomise the satisfaction of just those needs which in the human experience of the leaders of our race have been felt to be most imperative. Our general statement remains, therefore, essentially true, *i. e.*, that our new concepts arise out of the inadequacy of those already on hand to cope with the conditions in which we find ourselves.

The Process of Development of Concepts.—The development of our concepts after the period of infancy apparently proceeds along two main lines, which we can best discuss separately, although the two are at bottom really one: first, by the creation of essentially new concepts; and second, by the enrichment of old concepts with new material. An important factor in the formation of our concepts, *i. e.*, the process of judgment, cannot be discussed until the next chapter, where we shall, however, revert briefly to the conceptual activity.

A. Formation of New Concepts.—We have already seen that concepts are primarily based upon perceptual processes, just as memory and imagination are. We have also observed the way in which every perception, even the freshest and most novel, involves past experience. We shall, therefore, be safe in assuming that what we call new concepts are only partially new, and really contain a measure of familiar material. For example, when a boy first studies algebra he is introduced to the concept of the equation, to the concept of symbolism in quantitative procedure, to the concept of negative numbers, etc. Now, we speak of such concepts as being new to the boy, and so in a sense they are. But we must also recognise the fact that they are not wholly new, and that if they were they would be entirely unintelligible to him. The significance of the equation as a mathematical tool could never be grasped were the boy's previous experience incapable of furnishing him the notion of equality as a starting point.

What the boy does in getting hold of such a new concept as that of negative numbers is to *compare* the new notion with his old idea of number, to remark their likenesses and differences, and to throw into the foreground, by this process of discrimination, the most practically important features of the new case. The result of this procedure is the boy's first concept of negative numbers. These abstracting, discriminating, and comparing activities are present in varying degree in all self-directed attainments of new concepts.

This form of development of ideas displays in an unmistakable manner the essentially organic nature of our knowledge. Each idea springs out of other ideas, which have gone before, and in turn gives birth to new successors. The connection is not merely one of sequence in time; it is a connection of the genuinely developmental type, in which one idea is, as it were, unfolded from, and given off by, another. Ultimately, therefore, each of our ideas is related, however remotely, to all the others, a fact which constitutes one illustration of the so-called doctrine of the total relativity of knowledge. Speaking metaphorically, but within the bounds of literal fact, we may say that the great tree of knowledge springs from the seed of that vague consciousness with which the infant's life begins. Differentiation followed by fresh synthesis, old experiences blended with new ones, each modifying the other—such is the course of progress.

B. Enrichment of Old Concepts.—Hand in hand with the appearance of relatively new concepts goes the development of our old ideas. This development might be described as having two directions, but in reality the two are one. Our concepts seem sometimes to widen and sometimes to grow more narrow. Thus, we learn more every day about men and women, and so we may truly enough say that our concept of humanity broadens as our experience becomes richer. On the other hand our concept of science may, as our knowledge increases, become more and more restricted in its scope. Many branches of inquiry which would originally have found place under this heading may, in our maturer judgment, belong elsewhere. Both these processes are, however, simply different modes of reaching an identical result, *i. e., the clarification of the precise meaning of our concepts.*

Every concept is in a sense a working hypothesis, a tentative manner of thinking about things, and is subject at need to revision. Our idea of right is gained in childhood from parental precepts. If we do not stagnate morally, a time must come when we are obliged to reconstruct and modify this childish concept. As our knowledge becomes broader this process of reconstruction may go on indefinitely. This does not mean that we necessarily discard wholly the idea of right which we received from our parents. Far from it! It means that this idea was necessarily a child's idea, and so inadequate to certain adult experiences; and it becomes necessary to develop it in accordance with the new needs. The incentive to this form of growth in our concepts is, then, precisely identical with that which led to our getting what we call new concepts. It is clear that in a certain sense the process we have just described really gives us new concepts. But practically we think of the new idea as a modification of the old one.

The doctrine is sometimes held that our concepts are unchangeable. The difference between this view and the one we have been presenting is largely verbal. In a certain sense our concepts are unalterable. To use our last illustration again, I can remember what I meant by my childish idea of right, and can recall the idea when I will. In this sense the concept does remain a permanent part of my mental equipment, undergoing only such changes as may be due to failing memory. But practically my adult concept which I call my idea of right is, as has just been shown, very different from this childish one out of which it has grown.

The Petrifying of Concepts.—That concepts *may* cease to grow and change is shown by observation of persons who have once settled down into a fixed and narrow vocation in which radically *new demands* are rarely encountered, and when encountered, are found hopelessly baffling. In a degree this condition is likely to overtake everybody as middle age passes by. The result is too often the pathetic person of inflexible sympathies, circumscribed and dogmatic ideas—the person who is sure the world is going to the bow-wows, and knows it was all much better in his own day. Such persons have ceased to get new concepts, and the old ones are inadequate.

CHAPTER XI

JUDGMENT AND THE ELEMENTS OF REASONING

The mental operations which we have thus far described find the culmination of their development in the process which we know as reasoning. This does not mean that reasoning is a totally new form of psychical activity, to which the others are subordinate. It means that in the process of reasoning the full implication and significance of these other conscious processes come clearly to light, while in it they reach their completed evolution. Moreover, it does not mean that reasoning is a form of process which appears only after the other processes which we have studied have been developed. Rudimentary reasoning is present from the beginning of conscious life in the human being, and is clearly involved in each of the processes we have thus far analysed. But in the gradual unfolding of consciousness, by means of which it comes to maturity, we meet more and more complex instances of reasoning, and at each stage we find it involving perception and memory and imagination and conception. At each stage it affords the best index of the real value of these other processes, and in its most elaborate forms it brings out in the clearest possible way their real function. We shall revert to these points more fully later in the chapter. We may define reasoning broadly as *purposive thinking,* that is to say, thinking carried on in the interests of some plan which we wish to execute, some problem which we wish to solve, some difficulty which we wish to surmount. The remainder of our discussion will serve to explain an justify our definition.

Analysis of Reasoning.—We are often told that the great educational value of mathematics lies in teaching us to reason correctly. Some hardy iconoclasts have ventured to question the extent of the value to be gained from the subject on this score, but at least it seems to be universally admitted that mathematics involves reasoning, and we may, therefore, judiciously seek from it an illustration of the reasoning process for our examination. Take the following arithmetical problem, reminiscent of the perplexities of the days of our academic youth. If thirteen melons cost a dollar and forty-three cents, how much should twenty melons cost? Most of us would solve this problem by finding the cost of one melon through the division of one hundred and forty-three by thirteen; and then the cost of twenty melons by multiplying this quotient by twenty. When the problem is distinctly understood, there instantly comes into our minds through our memory habits, the idea "cost of one melon"; and straightway we find ourselves executing the relatively habitual process of division. This accomplished, our minds immediately turn—again by virtue of our mental habits—to the multiplication of our quotient by twenty. The reasoning in a case of this kind, therefore, seems to involve the selection of certain ideas out of all those supplied us by the problem, the manipulation of these ideas in accordance with previously acquired habits, and the attainment of the solution by a proper combination of these two processes. So far as there is any originality in such a procedure, we must look for it in the skill and expedition with which we hit upon the right idea to work with, and the accuracy and promptness with which we apply to it the fruits of our previously acquired knowledge.

Should we examine a little more closely the nature of these ideas which we employ, we should find that they are clearly concepts. Thus, melon is a concept, cost is a concept, cent is a concept, etc. Were we to give verbal form to the several steps in the process, which we do not always do, we should find that we had such expressions before us as this: one melon eleven cents—eleven times twenty is two hundred and twenty, is two dollars and twenty cents. In other words, we put the concepts together in a form which the psychologists call a judgment. A judgment, when put into words, is what logicians call a proposition, and what grammarians call a sentence. It accordingly appears that a process of reasoning, such as that of our illustration, contains concepts combined in the form of judgments. We have already examined the nature of the concept, but judgment is a new mental operation to which we must now devote our attention.

Analysis of Judgment.—It will facilitate our investigation to begin with those cases of judgment to which we give verbal expression, for they can readily be secured in a concrete form, stripped of the introspective difficulties which beset the analysis of other varieties. It will suggest itself at once that, if the judgment is in any measure equivalent to a proposition or a sentence, we ought to gain assistance, in the distinguishing of its principal forms, from the classifications of the grammarians and logicians. Although the exact meaning of mental judgments and linguistic propositions are not always identical, even where they have the same verbal form, nevertheless many of these classifications are undoubtedly available; and we may expect to find assertative judgments, hypothetical judgments, disjunctive judgments, and so on. In the judgment, "the book is heavy," we have the concept heavy united to the concept book. On the other hand, in the judgment, "the book is not heavy," we have the concepts apparently sundered from one another. Even in this case, however, it is obvious that in the mental state, of which the judgment is the expression, the two *ideas* were together, as truly as in the first case. It is only so far as the ideas refer to objects distinct from themselves that their separation is asserted. In the judgment, "if the storm is severe, the ship will be imperilled," we have two pairs of concepts united to one another, *i. e.*, "storm" and "severe," "ship" and "imperilled." Like the preceding cases, the ideas are brought together mentally, but the *objective* union of one pair is made dependent upon the objective union of the other. The judgment, "Mr. Smith is either a democrat or a populist," gives us a typical instance of disjunction. The concept "Smith" is conjoined mentally with the two concepts "democrat" and "populist," and the *objective* union is asserted of one *or* the other.* In all these verbal precipitates of judgment we seem then to have *two or more ideas mentally united in meanings* which may imply either the postulated union or severance of the objects to which they refer.

Analytic-Synthetic Judgments.—Availing ourselves of a further classification which the logicians employ, we may speak of analytic or of synthetic judgments. "This wood is white," is an instance of the analytic judgment. It exhibits a property of the wood which is inherent in it, and may, therefore, be said to involve an analysis of the concept, "this wood." "Wood is combustible" is a synthetic judgment, because it adds to the idea of wood the idea of combustibility, which is not immediately, nor obviously, implied in it. We shall presently see reason to believe that synthetic and analytic judgments are psychologically really one, and for our present purpose we can at least see that they involve, like all the other cases which we have examined, the mental synthesis of concepts, whose objective union, or separateness, we mentally predicate.

Genetic Relation of Concept and Judgment.—Having dis-

*The so-called "impersonal judgment" has caused logicians much controversy. "It rains" is an instance of it. At first sight it appears as though such a judgment could hardly be said to involve a synthesis of two ideas, or concepts, at all. On the whole it seems probable that this form of judgment represents a primitive type of the judging activity, out of which possibly our more elaborate forms have developed. If this be true, the nature of the impersonal judgment will become evident as we go on with our analysis.

covered in these verbal judgments the constant presence of concepts, it will be well to revert to our account of their development, and detect, if possible, the relation of the judgment to this process.

We observed, when studying the origin of concepts, that they spring out of the mind's effort to mark off, and render distinct, the various meanings with which it has to deal. We saw that in the course of experience these meanings grow in definiteness and scope, so that a concept which meets the demands of childhood often needs for the purposes of the adult either to be reconstructed or else discarded in favour of some more adequate notion. If we examine once again some specific instances of the attainment and development of a concept, we shall come upon an instructive fact concerning the relation between conception and judgment. If we consider in this way our concept badness, we find that it has its origin in our very early childish experiences in connection with certain acts for which we were reproved or punished. The notion of parental disapproval quickly became attached to such acts, and, as soon as language could be comprehended at all, we remarked that they received the common appellation, "bad." Unless our account of the memory processes be fundamentally defective, the thought of such deeds should call to mind, in however vague a way, the undesirable consequences which had previously accompanied them. At this early stage, then, we must in a nebulous sort of fashion have brought together in our minds the idea of the act and the idea of its effects in the nature of punishment.

Such a mental act obviously has implicit in it the beginnings of judgment, *i. e., the assertion of a relation between the mental elements.* When, with increasing age, language finally comes to our assistance, we are easily able to apprehend the usage of our elders, and we straightway apply the term "bad" to all acts of a certain character. At this point the idea of badness is for us synonymous with a certain list of acts with which various kinds of adult disapproval are connected. When we are inspired to perform such an act, we promptly execute mentally the judging process equivalent to labelling the act bad. Were we to put our thought into words, we should undoubtedly have a verbal judgment. All of which seems to indicate with no great uncertainty that the origin of such a concept as "badness" is to be found in mental processes which are in their nascent stages crude, vague, undeveloped judgments, involving a rudimentary recognition of relations between certain more or less distinct portions of our experience. We get at these elements of experience mentally by means of rudely distinguished ideas—in the case of our illustration the idea of the act and the idea of its consequences. Such concepts as this, *i. e.*, badness, owe their creation, then, to elaborations of already attained ideas in a primitive form of judgment.

Moreover, if we turn our attention to the subsequent history of such a concept as badness, we find unmistakably, as was pointed out in the last chapter, that its development is accomplished by means of new judgments which are brought to bear upon it from time to time. In childhood, for example, badness may for a long time mean, among other things, disobedience. There comes a time, however, when possibly disobedience seems in some crisis the only alternative to lying. We have also identified lying with badness. What shall we do? Well, whatever we do, we have at least laid the foundation for the reconstructive development of our concept of badness, by noting that disobedience may sometimes be necessary to the attainment of the maximal possible good. We necessarily make judgments about badness in such a case, and the transformation, whether shrinkage or enlargement, which the concept undergoes, is a direct expression of the effect of judgment. The development as well as the origin of such concepts is, accordingly, most intimately bound up with the judging operation.

Before generalising upon this single case, it would, of course, be desirable to examine every variety of concept in order to see if any of them originate independently of such judgments. This is, however, evidently impracticable, and we shall have to fall back upon the consideration that inasmuch as the concept is always a mental recognition, or designation, of specific meaning, there must, in the nature of the case, sooner or later be a judging process involved in it; for judgment is neither more nor less than the overt recognition and expression of just such relations as are embodied in the concept. We must not forget, however, that our common every-day concepts are often formed under the pressure of practical experience with little or no conscious reflection, and by means of the most rudimentary and implicit types of judgment.

Order of Development of the Cognitive Processes.—This analysis inevitably raises the question as to what is the most primitive and fundamental mode of conscious operation to which we have thus far given attention. We have shown that the conceptual element is present in perception, and we had already explained that in a genetic sense perception evidently antedates memory and imagination. Now we seem to find judgment as a precursor of the concept. What is the real order of development among these activities?

To secure a correct impression regarding the genetic relations among these processes, we must resort to an analogy which we have employed on a number of previous occasions. The development of an organism of any kind is accomplished by means of the gradual unfolding of structures, and the gradual evolution of functions, out of undifferentiated matrices. The fertilised ovum contains in a way, implicit within itself, all the potentialities of the fully developed organism which may subsequently grow out of it. But no inspection which we could make of the ovum would enable us to detect these invisible members. Step by step the homogeneity of the ovum gives way to more and more complex conditions, until finally the process of assimilation and differentiation issues in the full-grown organism. At each step in the progress toward maturity the several anatomical organs and the various physiological functions are moving together toward completion. At one stage one group of these elements may seem further advanced than others, but there is nevertheless mutual dependence of each factor upon every other, and each member of the several groups is from the beginning represented by some forerunner, however crude.

So it is with the psychical operations which we have been studying. Judgment, conception, memory, imagination, perception, and still other processes, which we have not as yet examined, appear in consciousness in crude embryonic form from the very first; and each process, which we have described and analysed under one or another of these names, in its developed condition really involves each of the other processes. At certain moments consciousness presents itself as dominantly engaged in the way we call *perception,* sometimes in the way we call *imagination.* But each operation involves the other, and it would hardly be possible to point to a stage in development where one was obviously present and the other obviously and altogether absent.

Judging is in a precisely similar situation as regards its primary or secondary nature, its early or late appearance, in the history of the individual consciousness. We may, perhaps, make this point clear most easily by examining the case of perception which we have seen to be present past all reasonable question from the earliest moments of waking life. When we perceive a familiar object, say a chair, the mental operation of cognising the object is essentially equivalent to the assertion, "this is a chair," or "this is a thing to sit upon." True, we rarely put the conclusion in this explicit form to ourselves. Nevertheless, the mental process is practically akin to the proposition, and in our first *intelligent* application of names to objects it is exactly of this character. Indeed, the first childish exclamations, which represent in however amorphous a fashion the precursors of language, are of this type. The whole mass of feelings which such early infantile vocalisation may serve to indicate is often extremely complex and extended. One sound may designate an experience, which as adults we should describe as "this-is-the-sound-of-the-coming-to-take-me-up-and-feed-me-which-is-a-delightful-experience." Another sound may represent judgments in the form of a command, such as "I-am-hot-and I-wish-you-would-take-the-blanket-off."

Let it not be supposed that we mean to credit the half-inarticulate infant with the mental recognition of all the differentiated elements in these cases to which we as adults are sensitive. Quite the contrary. It seems probable, as we saw, when we discussed attention and discrimination, that the early experiences of the baby are extremely vague, not in the sense of being *positively* confused, as adults sometimes are when embarrassed, but in the negative sense, in which vagueness means absence of distinct, well-recognized mental control. These primitive judgments are rudimentary expressions of *just such reactions* upon those indefinite, undifferentiated features of infant consciousness as we find appearing in ourselves when we make judgments about our more highly elaborated and more definitely discriminated ideas. The earliest rudimentary processes of judgment consequently involve the manipulation of unanalysed masses of experience, which we subsequently discover, through processes of dissociation, comparison, and judgment, to be extremely complex. It is quite possible, as has been already suggested, that the impersonal judgments, such as "it thunders," represent survivals of assertions of just this primitive kind about total experiences whose elements are only vaguely and imperfectly analysed.

Judgment as the Primitive Cognitive Activity.—It seems highly probable from the foregoing that in its original form all judgment is essentially a reaction upon immediately present perceptual experiences. Undoubtedly, rude judgments in which memory and imagination play leading rôles may occur at a very early period. But it seems quite certain that their most important functions must come somewhat later than the periods during which *perceptual* judgments are first clearly in evidence. Moreover, inasmuch as these rudimentary forms of judgment appear to involve as their most characteristic features, like the highly developed ideational judgments, the recognition, or assertion, of relations, it seems impossible to deny that the simplest case of perception, with its connection of a sensory stimulation with something already familiar, is also implicitly, at least, of the same genus as the judgment.

When we ask, then, which of the several mental processes we have described is most fundamental, we must reply that if the question applies to the *order* of appearance in consciousness after the hypothetical first sensation, no single one enjoys this preëminence. They develop together, and are all, in one way or another, present from the outset of conscious life. Indeed, they owe their separateness chiefly to our analysis and not to any natural isolation from one another. If the question means, however, which of the processes, as we have distinguished them, exhibits most conspicuously the whole scope of cognitive conscious capacities, then we must probably reply, judgment; because in this activity the detection and manipulation of relations is possibly most obvious, and this undoubtedly is the great mental achievement in the building up of knowledge and the controlling of conduct, to which ultimately all these processes revert for their final significance. In this sense, therefore, judgment is the most fundamental operation of consciousness on the cognitive side.

Judgment a Process of Ordering and Organizing Mental Material.—Before leaving this account of judgment and passing on to consider reasoning, a further word should be said of the fact which came to our notice a moment ago in speaking of the judging process in the primitive consciousness of infant life. Judgment undoubtedly begins with a process of disentangling the various constituents of some large and relatively vague experience. The operation which we described in an earlier chapter as discrimination is commonly identical with these rudimentary judging processes. Now in so far as judgment does really deal in this way with the analysis of ideational (or perceptual) experiences, which are to start with undifferentiated wholes, it would seem to be necessary to regard it as a process in which relatively vague ideas are resolved into their definite constituents, rather than as a process in which already distinct and separate ideas are brought together. It will be remembered that our previous description of it is more closely allied to the second of these views about it. As a matter of fact both views are correct in the conception which they emphasise, and the disparity between them is only apparent.

Just as we saw was the case in the differentiation of the various sensations out of the relatively homogeneous conscious continuum with which life probably begins, so the materials upon which our judgments are based and with which they deal are all necessarily elements of our own personal experience. So far as we predicate anything of an object,—for example, "iron is a metal,"—it may be said that we have simply *dissected the idea* of iron (our concept), which was already present to our minds, instead of adding to it some *new* idea, *i. e.*, metal. Taken literally, this is a true statement of the facts. It is only false by virtue of that which it fails to add. The concept of iron is a concept distinguished from that of metal. We not only *may* bring these two concepts together mentally, but we frequently *do* unite just such concepts in the form of judgments, which are practically valuable to us in enabling us to emphasise such phases of our thoughts as are momentarily important for us. Judgment is, then, in its most explicit forms, undoubtedly a process in which we synthesise concepts in the course of noting and asserting relations. Yet the concepts which we thus unite are with equal certainty already elements of our stock of knowledge, and so we may seem to have made no gain by the judgment, much less to have added a *new* idea to some old idea. But the gain is often very real, because the synthesis may bring out relations of which previously we were not clearly cognisant. From this point of view judgment is not so much a matter of creating wholly new mental material as it is a matter of *ordering and organizing* our mental equipment in the most efficient possible manner.

CHAPTER XII

THE FORMS AND FUNCTIONS OF REASONING

Judgment and Reasoning.—From the illustration with which we set out in the last chapter in our first rough analysis of reasoning, we observed that the solution of the problem with which we were hypothetically engaged involved a series of judgments. We therefore turned aside to examine more closely into the nature of judgment; and we have discovered that this is an analytic-synthetic process, in which concepts are employed and elaborated. As the great majority of our important concepts have a linguistic basis, it goes without saying that reasoning makes almost constant use of language. It now remains to survey somewhat more fully the manner in which our judgments are combined to form the various types of reasoning. We proposed as a somewhat provisional definition of reasoning, at the beginning of the last chapter, the phrase "purposive thinking," meaning by this to designate any thought process in which we were thinking toward some end, attempting to overcome some difficulty, or solve some problem. If we turn to certain familiar instances of this sort of thing in every-day life, we shall at once obtain an impression of the fashion in which we make use of our judging activities.

Practical Reasoning.—Suppose that we are about to make a long journey which necessitates a choice from among a number of possible routes. This is a case of the genuinely problematic kind. It requires reflection, a weighing of pros and cons, and the giving of a final decision in favour of one or another of the several alternatives. In such a case the procedure of most of us is after this order. We think of one route as being picturesque and wholly novel, but also as being expensive. We think of another as less interesting, but also as less expensive. A third is, we discover, the most expeditious, but also the most costly of the three. We find ourselves confronted, then, with the necessity of choosing with regard to the relative merits of cheapness, beauty, and speed. We proceed to consider these points in the light of all our interests, and the decision more or less makes itself. We find, for instance, that we must, under the circumstances, select the cheapest route.

Now, this process is evidently made up of a number of judgments, in which we have employed various conceptions of the routes and the consequences connected with their choice. Obviously, also, we have made constant use of the machinery of *association* by means of which the various connected ideas have called one another into the mind. Our conclusion is seemingly the outcome of a series of judgments, whose number may be wholly indeterminate, and whose order is far from systematic. Nevertheless, the process results in a solution of the problem, the conclusion is essentially a reasoned one, and the operation is altogether typical of the fashion in which we actually deal with the practical problems of common experience.

When we look at the successive steps a little more closely, we see that such judgments bring into the foreground some *aspect of the general problem* which assists us in viewing the situation in its entirety. Thus, the idea of cost as less by one route than by the others proved in our final estimate to be of fundamental significance. But we could not isolate this element of the problem and conceive it aright until we had compared routes with one another, and considered all the expenses involved in each. Only then were we in a position to assert which route was cheapest. This crucial judgment issued *immediately* from our comparison of the several routes with one another, but the process of *comparison* was itself an indispensable step in reaching our final choice. We considered speed in a similar manner, and found that all the routes were satisfactory enough in this particular.

Finally, the consideration of beauty and the pleasure of the journey is canvassed in like manner, and we find from the ideas which come into our minds that one route is markedly preferable. This factor of beauty remains, then, to settle accounts with the item of economy. The ultimate decision involves our taking stock of our financial status, past, present, and future, and the issue is settled on the basis of the story told by this set of facts. Each step in the process has been relatively simple, and entirely intelligible. We have allowed certain ideas, which we have *abstracted* in our *mode of conceiving the problem,* to take up by association other ideas related to them in ways which bear upon the case in hand; and from the judgments which we pass upon the meanings of these ideas our choice is made and our volition determined. Our effectiveness as practical reasoners (or theoretical reasoners, either, for that matter) will depend then, first, upon the skill with which we succeed in *conceiving* the problem correctly, and second, upon the *speed* and *accuracy* with which this conception suggests to our reasoning processes the recall of the special ideas appropriate to the case at hand.

The whole series of judgments employed could finally be reduced to two or three (or possibly to one), which, as the outcome of our tentative weighing of now this claim and now that, have proved to be finally significant. In a sense the judgments have all been connected and related. They have all arisen in response to our persistent dwelling upon the problem before us. But a few of them depend upon one another in an even more intimate way, and these are the permanently significant ones. For example: "Two routes cost more than $1000; I cannot afford to pay more than $800; I must therefore patronize the third route."

Value of Association by Similarity.—In so far as reasoning involves associative processes, it is clear that association by similarity will be of highest importance, especially in the more abstruse forms of thinking. The more complex types of problem with which we have to cope often require for their successful solution the application of facts and principles which have no connection with the matter in hand, save some fragile bond of *similarity*. The detection of these delicate links of relation is an achievement which characterises in high degree only the most remarkable minds, the geniuses. The rest of us find, to be sure, that we outstrip the brutes enormously in our capacity to employ this form of associative nexus. But the great revolutionary achievements in human reason have to wait upon the man and the hour, and when they are compassed, they generally reveal a marvellous manifestation of the capacity for discerning similarity. Newton's formulation of the law of gravity may serve to illustrate the point.

Reasoning and the Syllogism.—Now, to many persons the process of selecting a route for a journey will seem a misleading illustration of reasoning, because it will not appear to be sufficiently abstruse, nor sufficiently orderly and inevitable. It will represent what they may prefer to call "practical reasoning," as we have done, although we have not meant by the use of the term to deny to the process the essential character of reasoning. We shall be told that when we really reason we perform such mental deeds as the following syllogism exhibits:

All men are mortal;
Socrates is a man,
Therefore
Socrates is mortal.

Here we are assured we have new facts attained by reason; here is perfect order and symmetry, instead of miscellaneous groping for correct conclusions, which may, or may not, be attained; here are judgments arrayed in serried ranks, each supported by its neighbour, and the final judgment an irrefutable consequence of its companions, from which our thinking set out.

In response to this suggestion we have only to inquire whether or no our *original* thinking *really* goes on in this way, or whether this example illustrates the arrangement of which certain of our thought processes are susceptible *after* they have been pruned of excrescences. Our own view about this question is doubtless indicated by the mode in which we have approached it. There can be no doubt that the celebrated syllogism which we have just proposed reveals an extremely fundamental fact about the relations of certain of our judgments to one another. That the syllogism also represents the actual mode in which we commonly reach conclusions is altogether another proposition, and to one which assent certainly cannot be given. The question here at issue is purely one of fact, and each one must determine for himself whether in his reasoning processes he finds himself proceeding in the syllogistic manner.

When we examine our thinking, with this question in mind, most of us find that neither as regards the order of the several steps, nor as regards their number, does our common reasoning comply with the pattern of syllogism. In instances like that of our illustration we should rarely have any recourse to the second proposition, or the minor premise, as logicans call it, even provided we found it necessary to consider the truth of the conclusion. Moreover, it would as a rule be only in case we found it necessary to verify the truth of the concluding proposition that we should revert to either of the other propositions; and then the order of our thought would be—first, the conclusion; second, the major premise. So that neither the order nor the number of judgments corresponds to the syllogism with which we started.

As a device for exhibiting the source of our confidence in the truth of the conclusion, the syllogism undoubtedly possesses a value; for it makes explicit and clear in the fewest possible words the fundamentally important relations among the ideas involved. It is, however, as a method of exposition, demonstration, and proof, rather than as a type of actual constructive thinking, that it gets its chief significance. Nevertheless, it possesses one characteristic which is peculiar to many reflective processes, and to this we must briefly refer.

Deduction.—The major premise—"All men are mortal"—contains an assertion of a general principle which we have observed that we may use as a principle of verification for such an assertion as that of the conclusion—"Socrates is mortal." Now, general principles play essentially the same rôle in our thinking as do the general ideas which we discussed in the chapter on conception. They summarise, just as concepts do, large masses of human experience, and in our purposive thinking we repeatedly have occasion to employ them. We might call them complex concepts.

These general principles represent the counterparts in our conscious operations of the principle of habit in our motor coördinations. Just in so far as we regard them as really stable and well established, we use them almost reflexly in our thinking, and apply them without more ado to the determination of conclusions about such facts as they may concern. Thus, having assured ourselves that a certain act is really stealing, we instantly class it as despicable and wrong; having learned that a substance of peculiar appearance is wood, we are immediately prepared to find that it will burn; if we hear of the discovery of a new planet, we assume without question that it will possess an elliptical orbit. These reactions consist in applying to appropriate things the habitual accompaniments of specific objects, or events, in the form of general ideas, or principles, concerning *similar* objects and events. Such a process lends perspective to the special subject to which the principle is applied, by bringing it into overt connection with the experience to which it may be most immediately germane, while it enriches and fortifies the general principle itself by adding to its scope a new and definite instance. It demands no argument, beyond the mention of the facts just described, to demonstrate that we make a constant use of general principles in some such fashion as this.

The problem is at once suggested by the foregoing discussion of deduction, as to how we obtain the general principles therein at issue. This brings us to the complementary process which logicians designate induction.

Induction.—According to the familiar accounts of it, induction is the operation by means of which we come to generalise upon individual events. For example, having observed numbers of specific instances of the phenomenon, we come to the conclusion that all paper is combustible. In a similar way we come to assert that all mammals have lungs, that masses attract one another, etc., etc.

Criticism of Induction.—Now, logicians have argued at great length upon the question whether we really succeed by inductive inference in going beyond the particular facts which have actually been examined. They have also considered at great length the criterion, or warrant, upon which inductive principles proceed, supposing that they ever do transcend the facts from which they set out. Sometimes it has been maintained, for example, that the inductive generalisation, "All men are mortal," which is based upon our examination of a finite number of cases of human mortality, obtains its ultimate significance for knowledge simply by virtue of the assumed uniformity of nature. What has happened a number of times will always happen under like conditions, is the meaning of this view. Or, stated more rigidly, whatever has happened under given conditions will always happen under the same conditions. On this basis a single occurrence of a phenomonon, if thoroughly understood, would justify a generalisation about all other instances of the phenomenon. Many other views of the matter have been defended, but we can hardly enter upon them. Suffice it for our purposes to observe that whatever may be the final merit and reliability of inductive inferences, we do in our actual thinking make constant use of such generalisations, and on the whole with practical success.

Indeed, after our account of habit and association and our account of the formation and development of concepts, we should be ill-prepared for any other conclusion. Having found a certain characteristic common to a large number of events, it could not well be otherwise than that we should be predisposed by the principle of habit to connect this character with all other events which we judged to be of like kind. This would tend to occur on the level of mere trains of associative ideas, as in revery, where it might, however, often escape attention; it would also come out clearly in the recognition of points in common among such occurrences as we found ourselves obliged to reason about in the course of overcoming difficulties, whether practical or theoretical. Thus in revery our thoughts might run upon the planets, and as the ideas of them passed through our minds we should probably think of them all as spherical, and yet this common property might escape our definite notice. In reasoning, however, we should often find it indispensable to emphasise common qualities of this kind. So, for instance, in attempting to predict weather conditions we should speedily find it necessary to proceed on the generalisation that all low barometric phenomona were indicative of storm formation. The same exigencies, therefore, which lead us to form general ideas, also lead us to that special type of idea which we more often call a general principle and express in a proposition.

It may be added that undisciplined minds, following a tendency natural to us all, constantly generalize on *single events* which are imperfectly understood and consequently fall into persistent error. The fallacy consists, however, not so much in generalising on *one event* as in generalising on an event which is not correctly or fully apprehended.

Deduction and Induction Compared.—In comparing deduction and induction it is often said that induction necessarily precedes deduction, because we obviously cannot apply our general principles until we possess them, and it is by means of induction that we obtain them. It is also said that in deduction our thought proceeds from the more general to the less general, from the universal to the particular; whereas in induction the order of procedure is reversed. There is an element of truth in both assertions, but this form of expressing it is certainly misleading.

The truth in the first contention consists in the fact that all *general principles* are based upon *particular experiences.* But this does not mean that inductive processes occur first, and then at a later step deduction appears. Both kinds of process go on together, as we shall see in a moment. Indeed, strictly speaking, they are in the last analysis simply two phases of one and the same process. The truth in the second assertion resides in the fact that some portions of our thinking proceed under relatively more *habitual* forms than others. The deductive process represents the application of a mental habit, or principle, to a practical case, under just such conditions as we have already described. The inductive process represents more distinctly the *formation of these habits* of thought. In both cases, however, so far as concerns the progress of the successive thoughts, we always find that the advance is from particular to particular. Moreover, the advance is not so much an advance from the particular idea x to the independent and particular y, now shown to be related in some way to x, as it is a development of the idea x, hitherto undifferentiated in this special fashion, into the idea x containing a y relation. Thus, the generalisation about low barometric conditions and storm formation is not a mental process in which two wholly disconnected ideas are brought together. It is simply a process in which the hitherto unspecified experience "low-barometer-storm-formation" is resolved into its fuller significance for practical use. Similarly, in subsequent deductive operations with this principle, *i. e.,* all low barometric conditions indicate storms imminent, we proceed from the particular idea "low barometer," to the particular idea "storm forming." However convenient, therefore, it may at times prove to speak of passing from the general to the particular, and vice versa, we must remember that in our actual thought processes we always juxtapose particulars; or more precisely, we deal with discriminable features of a single mental particular. Of course it will be understood from our study of the development of concepts that these particulars are under this treatment modified incessantly, both by expansion and contraction.

Habit and Adaptation in Deduction and Induction.— We have seen from time to time throughout our work that each mental process which we have examined contains some old features and some new features, that it reflects the principle of habit and the principle of fresh adjustment to novel conditions. Induction and deduction are further illustrations of this same fact. Just as in perception we observed the new element in the sensory stimulus, and the old element in the reaction by a modified cortex, so we have seen that induction represents that function of our purposive thinking in which the new adjustment is uppermost; whereas deduction represents more conspicuously the application of acquired habits. If the parallel is really genuine, we should expect to find, as we have at each previous step, that the two attributes of novelty and familiarity in the elements employed are never entirely dissevered from one another, and so we should expect to find substantial warrant for our remark a few lines above, that induction and deduction are but phases of a common process. That they are actually conjoined in this way does not mean that they always are met with in a condition of perfect balance. It may much more naturally be expected that sometimes one and sometimes the other will present itself as more immediately important and more properly conspicuous. We have seen an analogous case in the instance of memory when compared with some kinds of perception. In the one case the obvious emphasis falls upon the new, in the other upon the old. So it is in reality with the relation between deduction and induction.

In reaching the induction, "all low barometer=storm formation," we may suppose a number of instances to have been examined before the generalisation is made. Now, the intelligent apprehension of the terms concerned in the judgments, that is, low barometer and storms, evidently involves a reference back to past experience, to past factors of knowledge, which is, as we have seen, the essential feature of deduction. Moreover, the actual procedure by which we assure ourselves of the tenability of such an induction consists in comparing mentally each new instance with previous similar instances. In this operation the old experiences practically occupy the place of general principles, under which we array the new case. So that the deductive characteristics are evidently present in an unmistakable way in inductive forms of reasoning.

Conversely, when we apply a general principle, or infer that a special consequence will follow an event, because of the general class to which it belongs, we inevitably avail ourselves of inductive methods, in so far as we label the new fact. When we predict a storm because we observe a fall in the barometer we are in reality dealing with a *new specific instance,* which we generalise in an essentially inductive way. We may call it a case of deduction, because we have already convinced ourselves of the invariability of the connection between the storm phenomena and the particular barometric conditions. Nevertheless, the actual mental process by means of which we make the prediction is quite as truly characterised by induction. We may feel reasonably confident, therefore, that the reasoning processes do not constitute any exception to the rule which we have previously enunciated, that all cognitive mental operations involve both old and new factors.

Reasoning and Purposive Thinking.—It ought now to be fairly clear that the precise significance which we attach to the term reasoning is largely a matter of arbitrary terminology. Undoubtedly some of our purposive thinking takes a highly abstract and systematised form. Undoubtedly, also, most of it goes on in a much more concrete, miscellaneous, hit-and-miss fashion. But it is essentially impossible to draw any sharp line marking off the more orderly and exact procedure from the more promiscuous form; and, as the presence of a dominating purpose, plan, or interest seems to control the ideational processes in both cases, it has seemed the simpler and more natural thing to call all purposive thinking reasoning. We are then entirely able to recognise stages of abstraction and complexity in the execution of such thinking without any sacrifice of regard for the facts.

Stages in Reasoning Processes.—We may distinguish three such stages separated from one another by no abrupt lines of demarcation, but designating three fairly distinct degrees in the levels of complexity and abstractness found in purposive thinking. First, there is the sort of persistent psycho-motor activity, relatively random in type, by means of which animals generally accomplish their purposes when called upon to meet novel situations. This sort of thing is illustrated by the efforts a hungry animal makes to get food when he is shut up in a cage. Second, there is the kind of process which involves meeting a difficulty simply by calling upon memory. This may be illustrated by the case of wishing to telephone a friend and, in the absence of a directory, being thrown back upon one's memory of the telephone number. Both these forms have various modifications. Thirdly, there is the process of reasoning in the narrower and more precise meaning of the term, in which a problematic situation is *analysed* and *conceived* in one fashion after another, and the abstract ideas thus precipitated are allowed to call up from past experience the associates relevant to the solution of the problem thus conceived. In the typical form of these cases, the old experience has itself to be split up and conceived in a new way appropriate to the special exigency at issue. This sort of process is represented by the steps involved in making some of the more complex mechanical inventions. The particular problem to be solved has to be isolated and clearly formulated. Then the items of old experience have to be canvassed and conceived in novel ways in order to permit application to the new case. Of course in certain instances totally new materials or results are encountered which were not anticipated, but wherever the outcome is a legitimate consequence of the reasoning, our description holds good.

General Function of Reasoning.—In reasoning, with its employment of concepts in judgments, we meet with the most highly evolved of all the psychical devices for assisting the adaptive activities of the organism, and this notion of its general significance is so familiar that it requires no detailed justification. Certain features of its practical operation may, however, profitably be described, especially in connection with our general notion of the relation between conscious and neuro-muscular processes.

In the original sensory stimulations of early infant life we have seen that there is a general overflow of the nervous energy into miscellaneous motor channels, occasioning heterogeneous and uncoördinated movements of various parts of the body. We have also traced in outline the process of the development by means of which the motor escapement becomes confined to certain limited and definite channels, and thus succeeds in establishing coördinated habitual movements. We have seen that these coördinations become more and more elaborate as growth proceeds, and we have noted that in this development the psychical processes which we have analysed as perception, imagination, and memory play an amazingly important part. Now, so far as we mean to cover by the term reasoning all purposive thinking, it is clear that these various mental operations just referred to can only contribute in a significant way to the modification of motor reactions in the measure in which they enter into processes of reasoning. It must be remembered again, that our purposive thinking is sometimes very rudimentary, simple, and abrupt; and at other times highly complicated, prolonged, and abstract. In reasoning we really find brought together and focalised all the important characteristics of the various mental modes which we have thus far studied.

This may be shown in the case of memory, as an illustration, but it is no truer to the facts here than it would be in the case of perception or imagination. If memory operated so as to bring into our consciousness ideas of our past experiences, but without any special reference to some present need, it would possess a certain intellectual interest comparable with that of a geyser, or other irregular natural phenomenon. But it would be an almost wholly useless adornment of our mental life. It is because memory enables us to recall experiences when we *need* to bring to bear upon some *present perplexity* the *significance* of our *past experience* that it assists us in getting ahead in the world. It is, in short, the part which it plays in purposive thinking which gives it its value. Moreover, this *significance* of the *past experience* is a thing which concretely brings with it tendencies to certain modes of *action*. It is not a mere reinstatement of *ideas* with which we are dealing in such a case. It is a reinstatement of ideas connected with which are certain quasi-habitual actions.

Similarly, though not always so obviously, with perceptual activities. If I am engaged in writing, *what* I perceive (my hand, the words, etc.) is certainly in part determined by my mental operations at the moment. Not only so, but my perceiving of the pen and paper are processes directly contributory to the expression of my purpose in my writing. The perception is taken up into the purposive thinking of the moment; or, expressing the facts more accurately, it is itself an integral part of the onward movement of my general purposive thought activities. I cannot execute efficiently that type of purpose which gets expression in writing without the assistance of the perceptual act. Always somewhere imbedded in the general matrix of our conduct, whether lying near the surface or deeply hidden in the recesses of our inner consciousness, we come upon purposes, plans, intentions, which explain our whereabouts and our action; and upon these basal factors rest our particular perceptions, as well as our other mental acts.

Neural Counterpart of Reasoning.—In a diagrammatic manner, but only in such manner, we can indicate the general neural counterpart of our purposive thinking, whether in its simpler, or in its more elaborate forms. In the case of our more distinctly habitual coördinations we long since observed how with a minimum of *conscious* accompaniments a sensory stimulus may make its way in the form of neural excitation from a sense organ directly through the (lower?) centres to appropriate muscular groups. This case is illustrated in the movement of the hand to throw the latch of a familiar door. In the case of stimulations which require a conscious reaction, whether simple or complex, the motor discharge is postponed, sometimes only for an instant, sometimes indefinitely. A typical instance which brings out the more important features of cases where persistent perplexities are involved is the following:

A man sleeping in a strange building is awakened by an alarm of fire. He hastily rises, throws on some clothing, and starts for the stairway. Up to this point the course of the successive neural events has been—auditory stimulus, memory activity, motor response with habitual coördinations, involved in dressing and running toward the remembered stairway. He finds the stairway already filled with smoke. Escape in this way is cut off and he turns back. Again sensory stimulus—this time partly visual, partly olfactory and auditory—and motor response of the habitual variety. His next thought is of a fire-escape, but none is to be discovered. He tries other rooms, but also without success. In these movements we have successive expressions of sensory stimuli, with memory intermediaries suggesting fire-escapes, each group of stimulations discharging into movements carrying him from place to place. Terror has rapidly been overcoming him, and his motions become violent and ill-controlled. Thus far his "reasoning" belongs wholly to the first two stages which we distinguished.

Let us suppose that at this point he begins to search for a rope to let himself down with. In the absence of any real rope, he suddenly hits upon the idea of using the bed-clothes for his purpose. By tying them together he manages to make a support upon which he swings himself to safety on the ground below. If he had not previously heard of such a use for bed-clothes, his thought would involve one essential feature of the most abstruse reasoning included in our third stage, *i. e.*, the *abstracting* through *conception* of one aspect of a situation, and the *novel application* of it to the effective meeting of a problem.

In this case we have essentially all the stages of practical reasoning processes involved. We have a problem, or a difficulty, reported in the form of a stimulus, which cannot be dealt with in a purely habitual, non-conscious fashion. The first effort to meet this obstacle consists in cortical excitations of relevant memory processes, and the expression of these in the forms of acquired coördinated movements. In many instances the first or second effort would, of course, have achieved success and cut short the remainder of the process.

In some more distinctly intellectual forms of problem the memory process would not necessarily express its bearings in the form of actual movements executed at the moment. But the excitation of the cortical activities is of precisely the same kind, and has precisely the same significance, as in the hypothetical case we are considering. Whenever the coördinations employed at the summons of the memory process, in the way we have described, prove inadequate to meet the difficulties in hand, there is always this same progress from one reaction to another, or else a recourse to the more abstract type of reasoning suggested in the illustration.

If the problem constitutes an insignificant stimulus, one or two failures to solve it may result in the abandonment of the effort in favour of some more pressing interest which enlists our more vivid feeling. But when, as in the case of our illustration, the significance of the problem is compelling, we often meet, after the failure of all the reactions suggested by memory and reasoning and executed by habitual coördinations, a remarkable phenomenon. The stimuli apparently continue gathering power, which can no longer be drained off in coherent motor responses, and presently we see very much what we observed with babies, *i. e.,* the breaking over of the neural excitement into almost every motor channel. We speak of persons in such a condition as panic-stricken. This diffusion in the case of infants is wholly uncoördinated, whereas with the adult it is coördinated in a measure, but incoherently, and with reference to no single purpose. Nevertheless, such mal-coördinations, which at least serve to bring the organism into new conditions, are sometimes, as in our illustrative case, successful in providing escape from difficulties. Animals make large use of such violent and random movements whenever they are confronted by strange and terrifying conditions. If, after memory and reason have done their work, there still be need for other forms of reaction, this sort of general motor explosion is really all that there is left to fall back upon. Our supposititious man might have thrown himself out of the window, as many others have done under the intellectually stupefying effects of extreme fear, but even so, the neural process would have been highly similar to that which we have described, and it represents the consequences of a practical breakdown in the coördinated movements suggested by memory as competent to meet the case at hand.

The neural process in the more abstruse forms of reasoning is probably quite like that which we have now described, save as regards the delicacy and infrequency of the associative links by means of which we pass from idea to idea in our effort to overcome mental difficulties. Sensory discrimination, intellectual abstraction, memory processes, judgments of comparison, habitual coördinations—in varying degree and in shifting combinations these factors are present in all types of reasoning, from the most concrete and simple to the most complicated and abstract.

Genesis of Reason in Human Beings.—The precise moment at which a child passes out of the stage of mere perceptual thinking and succeeds in creating concepts detached from particular events is not one that we can exactly determine, nor is it important that we should do so. It certainly comes in a rudimentary way with the voluntary control of his muscles, and it grows rapidly as soon as he gets control of language. In general, it may be said that its appearance is largely dependent upon the demands which the child's environment makes upon him. So long as he is a mere vegetable, fed and watered at definite intervals, conceptual thinking is of no great consequence. As he comes to attain more complex social relations, and as he finds himself surrounded with increasingly complex situations to deal with, conceptual thinking, with its classifying, simplifying characteristics, becomes essential to effective adaptation. Moreover, when such thinking does appear, we know that the child is beginning the evolution of that special part of his mental life which marks him off most definitely from the higher brutes. The organically purposive character of consciousness is of course manifest in its earliest and most rudimentary expressions, as has been repeatedly emphasised.

The Reasoning of Animals.—We gain an interesting side-light upon the reasoning processes of human beings, and especially upon the development of reasoning in children, by observing certain of the mental operations of animals. Two extreme views have been popularly entertained concerning the reasoning powers of animals. One of them is represented by the disposition to apostrophise man as the sole possessor of reason, the lord of creation, ruling over creatures of blind instinct. The other view has found expression in marvelling at the astounding intellectual feats of occasional domestic animals, or at the shrewdness and cunning of their brethren of the wild. Both kinds of animals have been forthwith accredited with the possession of reasoning powers of no mean pretensions. Of recent years rapid advances have been made in the scientific observation of animals, and it seems probable that at no remote day we may possess a fairly accurate impression of the scope and nature of their psychical lives. Meantime we must speak somewhat conservatively and tentatively.

Many of the acts of animals which have enlisted the most unbounded admiration are undoubtedly purely instinctive. And not only so, but it seems probable that many of these instincts are unconscious and just as truly reflex as the most uncontrollable of human reflexes, such as the iris. Thus, the remarkable actions of ants, whose astonishing system of coöperative government has furnished so many fine rhetorical figures, are apparently due to reflex reactions, to stimulations chiefly of an olfactory kind, to which they are probably obedient in an almost purely mechanical way.

Many acts of animals, which are at least effective expressions of mind, seem upon close examination to consist simply in associating certain impulses or acts with certain objects or situations. The original associating of the correct elements may have come about more or less accidentally, and is certainly often the result of many random trials. Thus, a young rat, in attempting to get into a box containing cheese, the entrance to which requires his digging away an amount of sawdust at one particular spot, will often scamper many times around and over the box before starting to dig. If after digging and finding the correct spot, he be removed and the sawdust replaced, the same sort of operation generally goes on as did at first, only now he succeeds much more rapidly than before. After a few trials he goes almost instantly to the correct spot, makes few or no useless movements, and promptly gets his reward.

In cases of this kind we see an animal endowed with a large number of motor impulses, which enable him by virtue of his sheer restlessness to achieve his original success in getting food. "Try-try-again" is the principle involved, but it is generally applied in a relatively blind and chaotic manner. Little by little the association between the food and the *efficacious* impulse becomes ingrained, all the others fall out, and to the observer, who is innocent of the previous stages of the process, his act appears highly intelligent. As the creature grows older an interesting change comes over his performances. If he be given a problem to solve similar to the one we have just described, he begins in a much calmer and more circumspect way than does his younger protégé. His first success may consequently be less quickly achieved. But in subsequent trials he becomes much more rapidly proficient, and one or two trials may be all that he requires to attain practical perfection in the act. In the mature rat the *memory process* is evidently much more active and reliable.

Reasoning processes of this kind—if one wishes so to label them—are much in evidence in little children. The small boy, striving to repair his toy, turns it this way and that, hammers it, and pulls it about. Sometimes success unexpectedly crowns his labours, and he may then be able to bring about the desired result again. He has a general wish to set his toy aright, much as the rat has his ambition in the matter of the cheese. Neither of them has any clear recognition of the means appropriate to the end, but both of them, by trying one move after another, finally come upon the correct combination, after which memory often enables them to repeat the achievement. In the light of our present knowledge it seems probable that the great mass of seemingly intelligent acts which animals perform, apart from instinctive acts, are of this variety, and therefore involve nothing more elaborate than the association of certain types of situation with certain motor impulses.

Do Animals Perceive Relations?—Just how far such acts may at times involve the perception of coherent *relations* in the manner characteristic of adult human intelligence, it is essentially impossible to say. The boy of our last illustration may, indeed, grasp at once the real relations involved in his problem and thenceforth his successes will be prompt and unfailing. The rat probably never apprehends these relations. One of the vigorously controverted points about animal intelligence comes to light here. Do animals form concepts of any kind? If they do not, they evidently cannot execute the intellectual processes peculiar to the more abstruse forms of human reasoning. Do animals ever employ association of similars in their psychical operations? If not, again we must deny to them one of the most significant features of human thinking. Do their gestures and attitudes, by means of which they seem to communicate with one another, ever rise to the level of real language, furnishing a social medium for definitely recognised meanings? On these points competent observers are not at present altogether agreed. It seems, however, probable that animals rarely, if ever, achieve the distinct separation of ideas and perceptions which human beings attain; and that they do not, therefore, understand relations or employ the concept in the form in which developed language permits the human to do.

The acts of certain of the apes, however, and occasional performances of some of the higher mammals, indicate a very considerable degree of *original* and intelligent reaction to sensory stimulations. It must be remembered of course that the higher animals differ in mental capacity from the very low animals only less than they differ from men. The animal consciousness is probably much more exclusively and continuously monopolised by mere awareness of bodily conditions than the human consciousness; it is much more preoccupied by recurrent and uncontrolled impulses, and much more rarely invaded in any definite manner by independent images of past experience. Meantime, we have to remember that the nervous system of the higher animals seems to afford all the necessary basis for the appearance and development of the simpler forms of rational consciousness, and the only difference in these processes, as compared with those of man, of which we can speak dogmatically and with entire confidence, is the difference in complexity and elaboration. Consciousness appears, then, everywhere as the index of problem-solving adaptive acts.

CHAPTER XIII

THE AFFECTIVE ELEMENTS OF CONSCIOUSNESS

Feeling and Cognition.—In the foregoing chapters our attention has been chiefly directed to those phases of our consciousness by means of which we come into the possession of knowledge. We have examined the several stages in cognition from its appearance in sensation up through the various steps to reasoning. We have noted the increasing complexity and the increasing definiteness which seem to characterise the development of this aspect of our minds, and we have traced so far as we could the neural basis of the several processes at issue. We have seen that the elements of our knowledge ultimately reduce to sensory activities, for which the immediate preconditions are specialised sense organs and a central nervous system. We have seen how the whole significance of the different stages in the cognitive operation is found in the devices which they represent to further the efficiency of the motor responses which the organism is constantly obliged to make to its environment. We have seen that memory, imagination, and reasoning are thus simply half-way houses between stimuli and reactions, which serve to permit the summoning of just those movements which the present situation demands, when interpreted in the light of the individual's past experience.

We stated explicitly at the outset of our analysis of these cognitive operations that we should be obliged temporarily to overlook certain other factors of our consciousness. We come now to take up one of these neglected processes which has as a matter of fact contributed to produce the results in many of our illustrations. This process is commonly known to psychologists as *feeling.* The word *feeling* has many other well-recognised meanings, and the function which it is made to subserve in this present connection is somewhat arbitrarily imposed upon it. Moreover, certain psychologists refuse to use it in this limited fashion. Sometimes it is made synonymous with consciousness, and writers speak of "feelings of objects as present or absent," "feelings of relation" and "feelings of assent." Again it is used to designate whatever is vague and unanalysed in the background of consciousness. Thus we "feel" much which we cannot describe. Both of these last two usages have much in common with the ordinary significance of the term in daily speech. But we shall employ it to designate in a general way those conscious processes which possess definite tone, which are not neutral or indifferent, but which represent distinct tendencies to such reactions as will assure either the continuance or discontinuance of the stimulus, as the case may be.

Cognitions and feelings are not two distinct kinds of entire mental states. They simply designate certain *distinguishing features* of such total psychical conditions. An act of memory or of reasoning is cognitive in so far as it involves knowledge processes. It is feeling in so far as it is *my* knowledge experienced in a *certain way,* with a certain tone.

A rough distinction is sometimes made between cognition and feeling by saying that cognition furnishes us the nouns and adjectives, the "whats" of our states of consciousness, while feeling affords the adverbial "how." What are you conscious of? An object, a picture. How does it affect you? Agreeably. The first question and answer bring out the cognitive factors, the second emphasise the feelings. Another line of demarcation which is sometimes proposed is based on the assertion that cognition informs us of objects and relations *external* to our minds, whereas feeling informs us of our own *internal* mental condition. The general character of the distinction will become more evident as we examine more carefully certain specific types of conscious experience.

Elementary Forms of Feeling, or Affection.—If we hold a prism up in the sunlight and throw the spectral colours upon a wall, we not only experience the various sensory qualities of the several colours, we also commonly experience pleasure. If we now turn and look at the sun, we not only see the orb, we also experience discomfort. Similarly, when we strike three tuning forks which harmonise with one another we hear the qualities of the component sounds and we also find them agreeable. Instances of disagreeable sounds will readily suggest themselves. We might examine our sensations of pressure, movement, temperature, smell, and taste, and find the same thing true, *i. e.*, that they are accompanied sometimes by pleasure and sometimes by discomfort. Moreover, we shall find the same kind of sensation, for example, the sensation of sweetness, at one time felt as agreeable, at another time as disagreeable. The converse case is represented by acquired tastes, such as the fondness for olives, where ordinarily the taste is originally unpleasant, but subsequently becomes highly agreeable. Finally, there are many sensations which seem to be essentially neutral and indifferent. We cannot say with confidence that they are clearly and positively either pleasant or unpleasant. Many colours and many sounds are in this manner all but impossible to classify as agreeable or disagreeable. Ideas also, as well as sensations, display escorts of agreeable or disagreeable character. It would, therefore, appear that pleasantness and unpleasantness are attributes of consciousness which, although they may accompany sensory and ideational activities, are distinguishable from sensations. Apparently sensory forms of consciousness may occur without any, or at all events without any unmistakable, accompanying process of agreeableness and disagreeableness. On the other hand, it does not seem possible to point out any case in which the consciousness of pleasantness and unpleasantness occurs independently of sensations or ideas. The agreeable-disagreeable *element* or *phase* of our states of consciousness is often spoken of as "affection," the *total complex state* in which it occurs, including sensory and ideational elements, being then called "feeling." This seems a convenient usage, even if somewhat arbitrary, and we shall therefore adopt it.

Theories of Wundt and Royce.—Wundt and Royce have recently maintained that there are other elementary dimensions of feeling in addition to those of pleasantness and unpleasantness. Both of these writers speak of feelings of excitement and calm, and Wundt adds a third group, *i. e.*, feelings of strain and relaxation. It is contended that the individual members of these several groups may, theoretically at least, be combined in any manner whatever. Thus, pleasantness may be accompanied by strain and excitement, or by excitement alone, or by increasing quiet alone.

A detailed criticism of these views is not to be thought of at this time. The author can only indicate the general grounds of his disagreement with these theories, and remark that their enunciation has not as yet called forth very extended assent from psychologists. That our general condition is sometimes one of strain and sometimes one of relaxation naturally admits of no doubt. But our awareness of this condition of strain or relaxation is due primarily to the peculiar kinæsthetic sensations which accompany such states and report the tension of our muscular system. This feature in consciousness is of a *sensory* nature therefore, and does not warrant a classification with the affective elements. Strain and relaxation may be at times general characteristics of the total attitude of consciousness towards its object. But they belong to the cognitive order of conscious processes.

Again, excitement and its opposite are characteristics which apply beyond question to the general activity of consciousness. But after we have subtracted the effects of such kinæsthetic and organic *sensations* as may be aroused, have we anything left to designate as the consciousness of excitement, except our awareness of the general vividness and rate of flow in our conscious states? When we are much excited, commonly our muscles are (some or all of them) tense, our respiration is abnormal, etc. When there is muscular quiet with absence of acute kinæsthetic sensations, only our consciousness of the intensity and rapidity of change in the conscious processes remains. Although we acknowledge, therefore, the appositeness of these new categories as applied to certain general modifications of our consciousness, we maintain that we become aware of these modifications through cognitive channels already recognised and described. We consequently prefer at present to abide by the older analysis of pleasantness and unpleasantness as the two modes of affection fundamentally distinct from sensation.

Pain Sensations and Affections.—It will be judicious before going further to forestall one fertile source of confusion in the description of affection. It will be remembered that in our account of sensations we noted pain, which, we saw reason to believe, probably has a definite nervous organ like other sensations. The characteristic conscious quality arising from this organ is, in the case of the skin, the cutting-pricking sensation. Pains from the viscera and other deep-seated tissues are more massive. If pain is like other sensations, it should sometimes prove agreeable and sometimes disagreeable, and again neutral. It may possibly seem to strain veracity somewhat to speak of this sensation as ever being neutral, much less agreeable. And yet slight sensations of this character are at least interesting, and many persons secure a certain thrill of pleasurable gratification in gently touching a wound, in approaching with the tongue a sore or loose tooth, etc. That these sensations quickly take on when intense an all but unbearable character is notorious. This disagreeableness constitutes the affective phase of these sensations, just as it does with those of sound or vision. When we speak of pain, we shall try to mean such states of consciousness as depend upon the operation of the pain nerves, in connection with which it must be remembered we most often obtain on the side of intensity our maximal experiences of the disagreeable. It is not possible at the present moment to indicate precisely how far pain nerves may be involved in the operation of the other sensory tracts, such as the visual, and therefore how far many of our unpleasant sensory experiences, such as occasionally arise from audition, vision, etc., may be referable to this source. Meantime, we shall follow the indication of the facts best established to-day, with a mental willingness to rehabilitate our conception whenever it may become conclusively inadequate.

Affection and Sensation.—In our study of sensation we discovered that intensity, duration, and extensity were fundamentally significant features in its constitution. If affection is connected with sensory activities, it is highly probable that it will be found related to changes in these basal sensory characteristics.

Relation of Affection to the Duration of Sensory Processes.—The case of duration is relatively simple and obvious. Sensory stimuli of extremely brief duration may, if we are attempting to attend to them, be somewhat unpleasant. Stimuli which are agreeable at first, such as certain tones, often become positively disagreeable if long continued, and always under such conditions become at least tedious. It must be remembered that in some instances, for example, cases of olfactory and thermal stimulation, the sense organ becomes either exhausted or adapted, as the case may be, and that for this reason the stimuli practically cease to be felt—cease properly to be stimuli. Such cases furnish exceptions to the statement above, which are exceptions in appearance only. Disagreeable stimuli when long continued become increasingly unpleasant until exhaustion sets in to relieve, often by unconsciousness, the strain upon the organism. There is, therefore, for any particular pleasure-giving stimulus a definite duration at which its possible agreeableness is at a maximum. Briefer stimulations are at least less agreeable, and longer ones become rather rapidly neutral or even unpleasant. Disagreeable stimuli probably have also a maximum unpleasantness at a definite period, but the limitations of these periods are much more difficult to determine with any approach to precision. All sensory experiences, if continued long enough, or repeated frequently enough, tend accordingly to lose their affective characteristics and become relatively neutral. As familiar instances of this, one may cite the gradual subsidence of our interest and pleasure in the beauties of nature when year after year we live in their presence; or the gradual disappearance of our annoyance and discomfort at the noise of a great city after a few days of exposure to it. Certain objects of a purely æsthetic character, such as statues, or paintings, may, however, retain their value for feeling throughout long periods.

Affection and the Intensity of Sensations.—The relations of affection to the intensity of sensation processes is extremely complex; among other reasons, because the intensity of a sensation is not wholly dependent upon the vigour of the stimulus, but upon the relations momentarily existing between the stimulus and the organism. When one has a headache the sound which otherwise might hardly be noticed seems extremely loud. Commonly, however, sensations of very weak intensity are either indifferent or slightly exasperating and unpleasant, and those of high intensity are usually unpleasant. Owing to the obvious connection of the sensory attributes of duration and intensity, we shall expect that affection will show variations in keeping with the relation between these two. A very brief stimulus of moderate intensity may affect the nervous system in a very slight degree. A moderate stimulus on the other hand, if long continued, may result in very intense neural activity, and so be accompanied finally by unpleasant affective tone, rather than by the agreeableness which generally belongs to moderate stimulation.

Affection and Extensity of Sensations.—We shall find that the extensity of sensation processes, when regarded alone, possesses no significance for the production of affective phenomena which has not already been exhibited under the head of intensity. A colour which seems to us beautiful, when a sufficient amount of it is presented to us, may become indifferent when its extent is very much diminished. This consists, practically, however, in substituting for a moderate intensity of visual stimulation one of very restricted intensity. On the side of extensity the variations in affective reactions are most important in connection with the perception of form, and to this feature we shall briefly refer at a later point.

Comparison of Affection with Sensation.—It may be remarked before we proceed to another phase of the matter in hand, that affection agrees with sensation in possessing degrees of intensity and duration, although it never displays extensity. Nor do we seem to localise it as we do sensations.* It apparently possesses only two fundamental qualities, agreeableness and disagreeableness, which shade through an imaginary zero point into one another. On both sides of this zero point there are ranges of conscious experience whose affective character we cannot introspectively verify with confidence, and we may call this zone the region of neutral affective tone. But we must not suppose that this involves a genuine third elementary quality of affection.

*The doctrine is sometimes maintained that our affective processes are in reality organic sensations chiefly connected with the vital organs of digestion, respiration and circulation. Our inability to localise them is referred to their necessarily diffused character. They are supposed to be called out either directly by appropriate external stimuli, or indirectly by the reflex motor consequences of such stimuli. The latter form would probably be the usual occurrence.

Apart from these two qualities, it seems probable that the only variations in affection itself are those which arise from differences in its intensity and duration. The more intimate phases of the changes dependent upon the shifting relations among these attributes we cannot at present enter upon. Wundt, however, maintains that an indefinite number of qualities of agreeableness and disagreeableness exist. Conclusive introspective proof bearing upon the matter is obviously difficult to obtain. *Feelings* of course vary indefinitely in quality, because the sensory, ideational, and motor elements which occur in them may be combined in innumerable ways. But that the qualities of the *affective elements* are correspondingly numerous is by no means clear.

Affection and Ideational Processes.—We have spoken first of affection in dependence upon sensory activities, in part because it is in this connection that it first appears, and in part because the fundamental facts are here more obvious and less complex in their surroundings. But affection is of course a frequent companion of ideational processes, and it is, indeed, in this sphere that it gains its greatest value for the highest types of human beings. We must, therefore, attempt to discover the main conditions under which it comes to light among ideas. We may conveniently take as the basis of our examination the processes which we analysed under the several headings of memory, imagination, and reasoning. Fortunately we shall find that the principles governing affection in these different cases are essentially identical. That our memories are sometimes agreeable and sometimes disagreeable needs only to be mentioned to be recognised as true. Oddly enough, as was long ago remarked, the memory of sorrow is often a joy to us, and the converse is equally true. It does not follow, therefore, that the affective colouring of an act of memory will be like that of the circumstances recalled. It may, or it may not, be similar. Moreover, either the original event or the recalling of it may be affectively neutral.

Affection a Concomitant of the Furthering, or Impeding of Ideational Activities.—What then determines the affective accompaniment of any specific act of memory? In a general way we may reply, the special conditions at the moment of recall. In a more detailed way we may say, whatever furthers conscious activity at the moment in progress will be felt as agreeable, whatever frustrates such activities will be felt as disagreeable. An illustration or two may help to make this clearer.

Suppose a man goes out to make a number of purchases. At the first shop he gives an order, and upon putting his hand into his pocket to get his purse and pay his bill he finds that the purse is gone. The purse contained a considerable sum of money, and a search through the outlying and generally unused pockets of the owner fails to disclose it. The immediate effect of this discovery is distinctly and unmistakably disagreeable. The matter in hand is evidently checked and broken up. Furthermore, the execution of various other cherished plans is instantly felt to be endangered. Thereupon, the victim turns his attention to the possible whereabouts of the purse. Suddenly it occurs to him that just before leaving home he changed his coat, and instantly the fate of the purse is clear to him. It is serenely resting in the pocket of the coat he previously had on, which is now in his closet. The result of this memory process is one of vivid pleasure. The business in hand can now go on. It may involve a trip home again, but at all events the money is still available, and the whole experience promptly becomes one of agreeable relief.

Suppose that in this same case, instead of being able to recall the circumstances assuring him of the safety of the purse, our illustrative individual had failed to find any such reassuring clue, and did on the other hand distinctly recall being roughly jostled by a group of suspicious-looking characters on the platform of the street car while on the way from his home. In this case the memory process would augment the unpleasantness of the original discovery of the loss. The activity which he had planned for himself would appear more than ever thwarted, and the disagreeableness of the experience might be so intense as to impress itself on his mind for many days to come.

Affection and Memory.—We shall find upon examination that the paradox referred to a few lines above finds its explanation in a manner altogether similar to that of this case just described. The remembrance of a previous success or of a former prosperity may be accompanied by the most disagreeable exasperation, because it jars upon the experiences of the present moment, from which everything but disaster may seem to have fled. Many persons in straitened circumstances often seek a pale and disappointing solace in the memory of better days. Pride makes in this way a vain effort to efface the brute reality of the present, but the effort is generally a melancholy failure. Happiness lies not in the contemplation of such a past, but in the earnest and absorbed performance of the task just at hand. On the other hand, the memory of privation and struggle, once success is achieved, may be pleasurable, because in this case the thought not only does nothing to thwart our present purposes and interests, but even augments our progress by a conviction of our own strength and capacity.

From these brief considerations it is evident that memory processes may contain very intense affective elements, and that apparently these will be painful, or at least unpleasant, when the thought which comes to mind serves to impede our immediate purposes and desires, especially if the impeding is sufficiently serious to arouse emotion; whereas they will be pleasurable when the suggested ideas contribute vigorously to the onward flow of our interests and intentions. Many memory processes stand midway between these extremes, and are neutrally toned.

Is There an Affective Memory?—An interesting question suggests itself at this point, upon which we may profitably dwell a moment. Do we have memories of our affective experiences in the same sense in which we have memories of ideas and perceptions? Before we essay an answer we must be sure that we understand exactly what the question means. When we remember events we find that at times the visual image, perhaps, of the surroundings comes into our minds. Sometimes words or motor images may flash upon us. Or, again, we may in reply to a question say, "Yes, I remember the circumstances," when in point of fact what we mean is that we are certain we could remember them if necessary, although we do not at the moment make any effort actually to recall them. This last form of memory for feelings we undoubtedly have. We can often say with confidence whether at a definite time we were experiencing pleasure, or displeasure, or neither. But if we actually attempt to recall the event, we find then, as we just remarked, that sometimes the recollection itself is affectively colourless, sometimes it has the affective character of the original event, and sometimes an opposite character. In a practical way, therefore, we have a memory of affective experiences as genuinely as we have in the case of ideas. We can tell what affective tone belonged to vivid experiences. But our ability to *reinstate* the *original affective tone* with the cognitive memory of an event is extremely defective. The reasons for this will be clearer after we have examined the neural basis of affection. But it may be said at once that we could only succeed fully in such reinstatement, provided we could reproduce all the organic conditions of the original experience. This is rarely, if ever, possible.

Affection and Imagination.—The case of imagination we may readily suppose will prove to be much like that of memory, for we discovered earlier in our work how closely related these two forms of conscious process are. This supposition we find to be correct, and the only important addition which we shall need to make to our previous account of the operation of affection in connection with memory will become manifest in our examination of reasoning, which we shall employ in its broadest meaning to apply to all grades of purposive thinking. This curt dismissal of the subject should not lead us to overlook the fact that in connection with the æsthetic use of imagination, whether in artistic construction, or in the appreciation of beauty created by others or by nature, we encounter many of the most vivid and most worthful of our affective experiences.

Affection and Reasoning.—In our analysis of reasoning we found that in its most rudimentary forms it seemed to reduce to the ability to apprehend relations and employ them constructively. Recognition we saw was, therefore, in a measure an elementary expression of the reasoning power akin to the crude forms of conception. It has sometimes been maintained by psychologists that all recognition, whether of object or relation, is as such agreeable. The objects or relations which we apprehend are, of course, often unpleasant. But whenever the content of our apprehension is itself indifferent, the act of identifying is said to be agreeable; hence the theory. The agreeableness is admitted to be inconsiderable in such cases as would be illustrated by a person's perception of a familiar book when his eyes chance to fall upon it in an accidental excursion about the room. But it is nevertheless said to be discernible even in instances of this kind, while in all cases of mental struggle with some baffling problem, the detection of a relevant relation, or the appearance of an appropriate idea, is welcomed with a thrill of unmistakable pleasure. Total states of consciousness of this kind, together with such antithetic cases as are mentioned a few lines below, are by certain psychologists designated as "intellectual feelings." Wholly strange surroundings, on the other hand, in which we find nothing familiar to recognise, are said to produce in us at times uneasiness and discomfort. Moreover, we are all familiar with the unpleasantness of an abortive effort to recall a name or a number, and the fruitless effort to solve a problem is often mentally most distressing. Evidently such a formula as that cited above contains a quota of truth, but it is also evident that exceptions are easy to find. In order to reach consistency we must look for the principle lying beneath these formulations. By examining the conditions under which we execute these relatings of conscious processes to one another, we may come upon the law governing their affective consequences.

It will clearly be judicious to follow the clue which we secured in our description of the affective aspect of memory. It is at least possible that this may prove to afford us a basal principle. If so, we shall expect that in so far as any apprehension of relations, or objects, furthers an enterprise at the moment dominating our consciousness, it will be agreeable; whereas in so far as it thwarts or checks such an interest it will be unpleasant. This certainly seems to hold true wherever it is possible to apply it to concrete facts. For example, strange things are not disagreeable, but quite the contrary, provided we are travelling for amusement. If we are in haste to reach some destination in a city, and find that we have accidentally left the street car at the wrong point and are in strange streets surrounded by totally unfamiliar houses, the experience may be momentarily very uncanny and disagreeable, after which it may strike us as amusing, or as exasperating, depending on the circumstances involved. The agreeableness or disagreeableness in the perception of such objects and such relations is, therefore, in no true sense primarily determined by their strangeness or their familiarity. It is determined by the manner in which the perception affects our purposes and interests.

On the other hand, the perception of a familiar object like one's own home may arouse either ennui, tedium, and a sense of unrest, or the keenest pleasure, depending not at all upon the familiarity of the object, but solely upon the mental condition in which we chance to be, and upon the relation which the object bears to this condition. If we are eager to see our parents to communicate some piece of good news, we may find the sight of home most delightful. If, on the other hand, we desire, in the midst of a hot summer, to get away to the sea, the very bricks of the house cry out and mock us in our discomfort.

On the whole it appears probable that the principle which obtains in these cases holds good throughout all the purposive thought processes of our mental life. In trains of thought where we almost lose ourselves in complete revery, as well as in those prolonged and strenuous mental operations by means of which we solve the more serious problems, practical or theoretical, with which our pathway is beset, in these and in all the intermediary transitional forms, agreeable feeling is the accompaniment of such ideas as further our momentary interests; disagreeableness, on the other hand, is the mark of those which obstruct or thwart those interests.

CHAPTER XIV

FEELING AND THE GENERAL PRINCIPLES OF AFFECTIVE CONSCIOUSNESS

Classifications of Feeling.—We are now in a position to recognise the fact that all forms of the cognitive activities are characterised at times by marked affective qualities. Our feelings may, therefore, be brought for classification under any of the several main forms of the knowledge process. In point of fact the usual classifications of feeling are actually based upon these cognitive factors, and we may profitably examine some of the principal divisions which are secured in this way, although we must remember that they are very misleading groupings if they are understood as arising primarily from peculiarities of the affective element in such complex feelings.

Sensuous and Intellectual Feelings.—Feelings are thus divided into sensuous and intellectual, depending upon whether they originate in, and chiefly terminate in, sense organ activities, or in central processes, like imagination. We have already seen that the affective part of such feelings, the agreeableness or disagreeableness, is probably one and the same, whatever their immediate occasion. It is, however, undoubtedly true, as our discussion in the early part of the previous chapter implied, that many feelings which belong to sensory processes are relatively confined in their significance to these immediate activities, whereas the intellectual feelings commonly run out into a bearing on larger and more remote portions of our mental life. The agreeableness of the taste of candy, for instance, or the delight in the fragrance of violets, commonly exhausts itself in the moment of enjoyment; whereas the pleasure of a fine picture pervades one's life long after the picture itself has passed from one's view. This distinction must not, however, be unduly magnified if the basis for it be laid in the mere part played by the sense organ, for it must be remembered that the picture also is seen by means of a sense organ. Moreover, the feeling which the picture calls out would commonly be designated æsthetic, rather than intellectual. It may be added that the eye and the ear are sometimes rather arbitrarily held to be the only "æsthetic senses." More often, perhaps, the term "intellectual feeling" is employed to cover such cases as wonder, surprise, curiosity, and interest, the apprehension of relations, the feeling of ignorance, and the like. It is intended to indicate primarily processes of definite affective tone in which there is distinct use made of intellectual capacities like discrimination, comparison, and inference. The real distinction, which is hinted at in this old and somewhat ambiguous division of feelings, is one that can only be understood correctly when we observe what functions various feelings subserve in the life of the organism. And to this we shall shortly turn.

Aesthetic, Ethical, Social, and Religious Feeling.—Other suggested divisions of feeling are the following: æsthetic, *e. g.*, feelings of beauty; ethical, *e. g.*, feelings of duty; social, *e. g.*, feelings of embarrassment; and religious, *e. g.*, feelings of reverence. These divisions, like the immediately preceding ones, are evidently based upon differences in the objects which call out the feeling, and result in different *cognitive* and *emotional* activities, rather than upon any necessary differences among the affective elements of the feeling itself. Furthermore, the divisions are obviously not wholly exclusive of one another. Ethical feelings always have a social aspect, religious feelings have moral bearings, and so on. Such classifications are undoubtedly suggestive and valuable in their indication of the great avenues along which our feelings are approached. But we must once more carefully guard ourselves against the misapprehension that the affective factor (which ostensibly constitutes, in the theory of many psychologists, the differentia of feeling from other forms of conscious process) is in any true sense the basis of the distinction from one another of these several types of so-called feeling. The specific forms of psychical experience which are peculiar to the various classes that have been mentioned can be examined more profitably in connection with our study of emotions, and we shall, therefore, postpone their further consideration until that time.

Neural Basis of the Affective Element in Feeling.—In our discussion of sensation we observed that the various sensory qualities depend upon the action of specific end-organs. We have now seen that the affective processes may occur in connection with any of the sensational or ideational activities. And the question naturally arises as to their neural basis. Unfortunately our positive and detailed knowledge about the matter is lamentably incomplete. The theory, however, which enjoys widest currency at the present time maintains that the two antithetical forms of affection represent the two opposing modes in which any neural activity may go on. They do not depend, therefore, as sensations and ideas primarily do, upon the action of *specific segments* of the nervous system; they are rather the counterparts of the manner in which the *whole nervous system* is affected by the activity initiated in any segment at a particular time. This fact is held accountable for our difficulty in localising them.*

From this point of view pleasure is correlated with physiologically useful and wholesome activities; pain and disagree-

* If the view (mentioned in the last chapter) that pleasantness and unpleasantness are but forms of organic sensations should prove true, it would obviously be necessary to regard their neural basis as similar to that of other sensory processes. Certain authors who entertain this theory regard pain as the elementary form of unpleasantness, and the tickle sensation as the elementary form of pleasantness. One writer ascribes itching to pain nerve activity.

ableness with the physiologically harmful. Thus, the theory would find the neural explanation for the unpleasant character of dazzling lights and loud, shrill sounds in the manner in which the nervous system as a whole is affected by the reaction from these violent stimulations of the optic and the auditory tracts respectively. The nervous action is conceived as being of a definite form, which is qualitatively similar for all disagreeable or injurious stimuli, but quantitatively different for stimuli of varying intensity or varying harmfulness. As these peripheral sensory tracts, when they are active, always influence more or less directly the whole nervous system, the affective reaction represents in reality the effect of the particular stimuli upon the whole organism. The agreeableness of a musical chord or a sweet odour would, on the basis of this theory, be referable to a normal and efficient reaction of the nerves; the disagreeableness of a discord or a nauseous odour would, on the other hand, find its explanation neurally in an excessive or internally mal-adapted reaction of the organism.

Marshall has put the matter somewhat differently, in a manner which certainly fits many of the facts most admirably. He connects pleasurable experience with the use of stored-up nervous energy in amounts less than that actually available, whereas unpleasant experience he connects with the use of nervous energy beyond the limits of the normal modes of functioning. We shall revert to this later. Münsterberg and others connect pleasantness and unpleasantness, respectively, with movements of extensor and flexor muscles, with conditions of innervation in the motor cortex and with expansion and contraction of the organism, a view which certainly has, despite its suggestiveness, only a very general and indefinite basis.

We shall accept the validity of the general conception formulated in the first two paragraphs of this section, although we have to admit that its precise meaning is often found to be vague when we insist upon detailed facts confirmatory of its contention. Moreover, there are some facts which lend themselves to incorporation in the theory only with extreme difficulty. We can best get an insight into the more important considerations by reverting to our fundamental conception of the purpose and significance of consciousness in organic life—a conception which we have stated so often as to render repetition superfluous.

General Function of Affective Consciousness.—Agreeableness and disagreeableness are the *immediate indices* of the significance for the organism of the various stimuli and responses which enter its experience. *Their function is to incite at once appropriate motor reactions.* They lead normally and instantly to attitudes of advance or retreat, appropriation or rejection. Indeed, they have well been called "mental attitudes" of acceptance and refusal. Evidently some such marks, or signs, in consciousness of the value of particular objects or movements are invaluable in the execution by mental processes of the part we have assigned to them. The sign in consciousness of the organically advantageous might very well have been something different from the experience we now name pleasure, and the sign of harmfulness might have been other than that which we now recognise as pain and disagreeableness. But some such symbols are all but indispensable, if the organism is to steer successfully among *new* surroundings and in strange environments. If it were necessary to await the loss of one's eyesight before discovering that dazzling lights were injurious, consciousness would certainly be little more than a pernicious aggravation. As a matter of fact such stimulations are instantly felt as disagreeable, and the mind without further information has forthwith a guide to the kind of action appropriate to the occasion. Similarly as regards agreeable experiences. When one is tired and hungry after fatigue and exposure to cold, any food may seem welcome, but warm and well-flavoured food tastes best and will be preferred when choice is possible. In such cases one needs no further experience than is afforded by specimens of the cold and the warm food to recognise which is more agreeable.

It is of course clear that the functions of the sensation pain and the affective process unpleasantness largely overlap. But the former finds its chief import in cases of immediate physical injury or disease, whereas the latter has its main utility in the higher, more indirect and remote implications of experience. This fact is well illustrated in the essentially invariable tendency of sensory pain to produce movements of aversion and retreat; whereas in certain painful emotions such as sorrow we may dwell indefinitely upon the source of our feeling.

Theory of the Priority of Affective Processes.—So fundamental is this significance of the affective processes in all those activities immediately connected with the maintenance of life in the individual and the race, that several psychologists of repute have defended the thesis that pleasure and displeasure are the primordial forms of mind, the other processes connected with the special senses being of later origin. It is interesting in this connection to note that one writer has assigned displeasure as the original form of consciousness; another, pleasure; while a third has advocated the hypothesis that the two appeared together in advance of other modes of mentality.

If space permitted, we might examine the evidence for these several points of view, but as this is out of the question, we may remark provisionally that if our analysis of the affective features of consciousness has been thus far correct, we cannot assent to any of the theories just mentioned. It may well be that with the more rudimentary types of mind, in which general undifferentiated attitudes are the conspicuous things, the affective factors of consciousness dominate over the distinctly sensory and ideational. It may be, too, that the first appearance of consciousness is in connection with the operation of the pain nerves, though this is wholly problematical. But affection, as we know it (and we have no right to go afield from such knowledge), is apparently not a form of consciousness independent of sensations and ideas. Quite the contrary; it invariably appears clearly *in connection* with them; whereas the sensations and ideas are occasionally wholly, or all but wholly, destitute of affective tone. Meantime, it should be reasonably certain that agreeableness and disagreeableness—as signs of the immediate import for the organism of particular moments of experience—are indispensable elements in the most successful functioning of consciousness. As Bain puts it, pleasure represents a heightening, and pain a lowering, of some or all of the vital processes, and consciousness is in this way given immediate information of the nature of the situation. We may accept Bain's formula in a general way, although it is far from clear that a raising of vitality is always the immediate outcome of pleasure, and a lowering of it an immediate consequence of discomfort.

Physiological Expressions of Feeling-Tone.—In connection with this general theory of agreeableness and disagreeableness as expressions respectively of the increase or decrease in organic vigour, certain investigators have reported constant and definite physiological changes accompanying the antitheses of affective tone. Pleasurable experiences are thus said to cause dilation of the peripheral blood-vessels, decreased rate in the heart beat, increased depth of breathing, and heightened tonus of all the voluntary muscles. Disagreeable experiences on the other hand are said to produce constriction of the peripheral blood-vessels, and in general a set of physiological phenomena exactly opposite to those just mentioned as arising from pleasure. Students of Wundt have attempted to demonstrate a similar parallelism between certain groups of these physiological changes and the six forms of elementary affective process which he recognises. Several competent experimentalists have failed to confirm any of these observations, and the phenomena are apparently verifiable only under certain very definite and normally infrequent conditions. Meantime, there can be no question that all the vital processes, including those of assimilation, secretion, and excretion, are profoundly influenced by intense affective conditions. The only question is whether they are always affected in the same way by a similar conscious tone, without regard to other circumstances. We shall have occasion to emphasise certain of these phenomena when we examine the emotions.

Genesis of the Affective Elements of Consciousness.—Following our method in previous cases we may ask, first, under what conditions affection makes its earliest appearance. So far as concerns the life history of any given individual, we may say that affection is undoubtedly coincident in its manifestations with the dawn of consciousness. The cry with which the child draws its first breath has led to the assertion that life begins, as well as ends, with pain. However this may be, there is every reason to think that the mental life of the new born babe is for many days one of vague sensory consciousness, dominated by relatively vivid antitheses of agreeableness and disagreeableness. Certainly the earliest expressions of infants suggest nothing so strongly as pleasure and pain.

If we inquire more closely into the conditions under which expressions of satisfaction and dissatisfaction arise, we find that they align themselves very suggestively with the doctrine which we have repeatedly formulated regarding the origin of consciousness in general. When the child is cold or hungry consciousness is called into play, for the organism does not possess, in its inherited mechanism of reflexes and automatic movements, any device adequate to cope with these difficulties. But the materials of voluntary muscular control have not as yet been acquired, and so the intense dammed-up nervous currents break over into the few pervious pathways of the quasi-reflex type. The crying muscles are liberally represented here, and the child's lamentation, which summons parental assistance, is the outcome of this motor escapement. If there were no damming up of the nervous currents, if the stimulus represented by the cold immediately resulted in releasing efficient motor reactions, there is no reason to suppose consciousness would be aroused. This, however, is not the case. The stimulations are there, and they become more and more insistent. The conditions for the appearance of conscious activity are, therefore, at hand, and if we may judge by external expressions it promptly comes to life. But it is confronted with a situation with which it cannot immediately deal. Now, whenever we encounter such circumstances as these, we shall always find that the affective tone is one of unpleasantness.

In very young babes instances of definite pleasure are somewhat more difficult to secure. The child spends most of its time in relatively deep sleep, and the expressions of gratification which it manifests are, for several days at least, ambiguous. When such expressions do appear, they are apt to be in connection with the satisfaction of hunger. They seem to represent a kind of ratification on the part of the organism of the activities which have been indulged to relieve hunger. Indeed, if we may judge by external appearances, supported by our knowledge of the conditions in adult life, the whole of this process of allaying hunger, as well as the final stage of satiety, is agreeable. The case is extremely interesting in the apparent contrast which it offers to the conditions of maturity. Prior to the securing of control over the voluntary muscles, the function of consciousness is necessarily in large measure that of an approving or disapproving onlooker, who has little power to make his opinions felt in action.

We have noted the conditions under which painfully toned consciousness is produced. It would seem at first sight as though these must be synonymous with all those circumstances in which obstacles were to be overcome, and therefore synonymous with *all* those cases where conscious activities would be required. This position is, however, only tenable provided we disregard the obvious fact that the organism is in course of development, and that at this early stage, when voluntary movements are not yet under control, the total significance of the various factors in its life is not superficially obvious. Disagreeableness is undoubtedly the counterpart of *continued inability* to cope with a demand laid upon the organism, and the degree of unpleasantness is roughly paralleled by the insistence and the poignancy of the demand. Agreeableness, on the other hand, is the psychical counterpart of effective modes of reaction to a situation. When the situation is being adequately met, therefore, we may expect to find pleasure appearing, whether the successful response has come as a result of definite voluntary acts, as it may in adult life, or as a result in part of outside assistance, as it does in the early days of infancy.

Why Consciousness Is So Often Neutrally Toned.—The question then suggests itself as to why we are not more vividly aware of agreeableness in the normal activities of every-day life. These activities involve more or less of voluntary coordinations, which for the most part go on efficiently, and should consequently, from the point of view we have adopted, produce pleasurable results in consciousness. We have intimated that as a matter of fact a large part of our mental life is neutrally toned. The reply to this query is, therefore, that in so far as we are provided with healthy bodily processes, and in so far as we are engaged in the effective solution of problems which confront us, our consciousness *is* agreeable in tone. But large parts of our daily undertakings are of a routine character verging upon habit, and in consequence require little vigorous conscious attention, and therefore call out little affective reaction. Moreover, it frequently happens that although our mental operations are efficiently executed from the standpoint of practical results, some of our intra-organic processes are slightly indisposed, and inasmuch as our consciousness reflects the totality of our organic condition, we find ourselves either experiencing very little pleasure, or else feeling positive discomfort.

General Theory of Affective Processes.—At the risk of a certain amount of repetition it seems judicious to formulate our general theory once again. It is evidently impossible to state the conditions under which agreeableness or disagreeableness is produced, by reference to any *single* set of activities with which our cognitive and volitional processes may be engaged. Consciousness always reflects more than a single group of such activities, and its affective character is always dependent upon the whole gamut of physiological operations going on at any given moment. Under conditions of perfect health we may often predict with much accuracy what the affective results of a given stimulus will be, because we know that ordinarily it will stimulate moderately a well-nourished nerve tract. But unusual neural conditions in any part of the organism may lead to the falsifying of our predictions at any time. The melody which charmed us to-day may irritate us to-morrow, and this not because the melody, or the auditory nerve, has either one changed in the meantime, but simply because the digestive processes which yesterday were orderly are to-day chaotic. We see, therefore, that our provisional formulations in the previous chapter were too simple to account for all the facts.

The evidence thus far examined points to the belief that disagreeableness always appears in infancy, as well as in adult life, in connection either with (1) diseased conditions of the organism, or (2) with excessive—or insufficient—neural stimulation, or (3) with the checking and impeding of conscious activity in its guidance of action. The third point may prove to be identical with the second. It is certainly identical in some instances. The function of the unpleasant in consciousness is, then, evidently to furnish an *immediate and unambiguous index of conditions which menace the welfare of the organism.* Agreeableness appears in connection with (1) healthful organic conditions, (2) the stimulation of nerves inside the limits of their ability to respond with maximal vigour, and (3) the free and efficient flow of consciousness, whatever its object. The obvious function of agreeableness is consequently found in the furnishing of *immediate exponents of organic welfare.* Neither agreeableness nor disagreeableness are unambiguously prophetic. Their important function is in the present. Their meaning for the future requires the light of intelligence and experience. The frenzied delights of a Bacchanalian orgy are certainly no reliable harbingers of health, nor are the pangs of the morrow necessarily indicative of inevitable future disaster. We may now advantageously examine a few typical instances of affective consciousness, in order to test the adequacy of our principle.

The agreeableness and disagreeableness which arise respectively from healthful or diseased conditions of the organism hardly require comment. The organic feelings of a strong, well-fed organism are distinctly buoyant and pleasant; whereas the depression of dyspepsia, the tedious discomfort of a severe cold, etc., are almost unmitigatedly disagreeable. The moderate stimulation of the sense organs by simple stimuli is normally agreeable, and their excessive stimulation normally disagreeable. The pleasure of exercise and the unpleasantness of extreme fatigue, the agreeableness of moderately intense simple colours and tones, and the disagreeableness of those which are very intense, the agreeableness of rhythms to which we can make easy and efficient response, and the unpleasantness of all other kinds, afford instances which we might multiply indefinitely:*

* Acquired tastes and the correlative loss of liking for certain objects constitute interesting instances of the development which goes on in the organism in connection with affective phenomena.

The intellectual processes involved in grappling with a problem in which we are interested are normally agreeable so long as we seem to be making progress. They speedily become exasperating if we seem to be getting nowhere; and if our minds, by reason of fatigue, distraction, or any other cause, refuse to bring to our aid the ideas which we feel are needed, the operation may become intolerable.

When our emotions are vigorously enlisted in such reflective processes the agreeableness or disagreeableness may be extremely intense. Thus to many persons reflections upon immortality, upon the mercy of God, and other religious ideas may be profoundly uplifting and deeply gratifying so long as the mind meets with no obstacle in working out its conceptions. On the other hand, the mental agony experienced in reaching the belief that immortality is unreal is to many persons who come to this conviction all but unbearable. In æsthetic pleasures the situation is ordinarily complicated by the presence of both sensory and intellectual factors. A beautiful picture not only appeals through its richness of colouring and its grace of line to the immediately sensory activities, it also suggests to us ideas which take hold of our sentiments, our emotions, and our intelligence, setting up in us strong tendencies to motor reactions of one or another kind.

Application of the Principles to Aesthetic Experience. A. Elementary Aesthetic Feelings.—There are certain elementary forms of æsthetic experience which deserve mention. No theory affords a wholly satisfactory explanation of these feelings, but the one which we have adopted is at least applicable.

It seems probable as regards the acquirements of taste that, in the case of gustatory sensations at least, certain organic changes in the neural activities take place, by means of which the end-organs adjust themselves to stimuli, which originally produced excessive reaction. The loss of liking for certain flavours may be due to a similar adaptation. The stimulus may become simply neutral, or it may come to elicit excessive reactions some of which may set up reflexes of the nausea type.

1. Colour and Tone.—To certain persons particular tones and colours are agreeable which to other persons are unpleasant. The same thing is true as regards the tastes and preferences of races. In general, primitive races and children are said to prefer brilliant hues. They seem also to enjoy tones which to cultivated adults are often shrill and harsh beyond endurance. Possibly the primitive eye and ear require a more strenuous stimulation than those of civilised peoples in order to effect a normal vigorous reaction. The same sort of individual and racial variation is found in *combinations* of colours and of sounds. Again we may plausibly refer such discrepancies to variations in the neural conditions which characterise the several persons involved.

In regard to tonal *harmony* we find a profuse literature devoted to the attempted proof of one or another explanatory hypothesis. It has been held that we unconsciously apprehend simple ratios in the vibration rates of tones and that this process produces conscious pleasure. In support of this view is the undoubted fact that most of the intervals which are agreeable are expressed in simple ratios (*e. g.,* 2 : 3; 4 : 5) of the vibration rates of the constituent tones. But the simplest ratios *i. e.,* the octaves 1 : 2, are not the most agreeable and the whole supposition of unconscious counting is repulsive to contemporary modes of thought.

Helmholtz held that any tones which do not by the interference of their vibrations *beat* with one another will be sensed as smooth and so agreeable. The analogy of flickering and constant lights is cited in support of this view. Rapidly intermittent sensations are apt to be unpleasant. This conception, however, makes harmony a purely negative fact, the absence of disagreeable roughness; and again, as in the previous case, requires supplementary hypotheses to explain why the smoothest intervals, like the octave, in which there is least of beating, should be less agreeable than others.

Wundt maintains that the facts are explicable by direct and indirect tone relationship, *i. e.,* the relations of the tones to one another, in reference to their *common* partial tones, or their relation to some *third tone* of which each is an overtone. This theory again formulates correctly many of the facts. Harmonious tones undoubtedly sustain such relationships to one another. But it gives no wholly satisfactory account of the specific order of fusion, or agreeableness either, in which we arrange the harmonious intervals.

In truth no theory has been proposed which really affords an *explanation* of all the facts. But our general hypothesis of normal and appropriate, as against physiologically inappropriate, excessive or insufficient stimulation, is still tenable in describing the conditions under which tones are pleasant or unpleasant. It suggests the direction in which at some future day a satisfactory explanation may be looked for. The whole problem is complicated by the phenomena of melody with its rhythmic motor elements. Into this subject, however, we cannot enter.

2. Lines and Forms.—Our preferences in the matter of lines and forms have been extensively studied without thus far arriving at any broad consistent theory. In a general way it is true that we find curved lines more agreeable than straight ones. Formerly this fact was referred to the *natural movement* of the eye, when free, in curved lines. Recent photographic studies of eye movements show that the eye does *not* move in curves even when following a curved line. It proceeds by irregular jerky movements which are essentially rectilinear for the most part. The two eyes do not even move together, one of them often lagging along behind the other, and sometimes making independent movements on its own account. Consequently it is said that the explanation of the beauty of curves must be found elsewhere than in these movements. Probably we must refer such feelings to some recondite suggestiveness of the curved line. Thus, the agreeableness may possibly be due to the suggestion of pleasurable movements of the hand and arm. The older æstheticians were wont to speak of the curve as combining unity in variety; the constant change in direction giving variety, the constant continuation of the movement furnishing the unity. It seems possible, too, that even though the eye does not itself follow a curved line when it moves, the innervation necessary to follow such a line may be organically easier, less fatiguing, and more agreeable than that required for a right line. There is a constant change of innervation in the one case and a relatively fixed innervation in the other. But it must be admitted here that broken lines which require constantly fresh innervation are less agreeable than continuous ones.

Symmetrical objects give us a sense of stability and rest as compared with unsymmetrical ones, which are apt to seem as though about to topple over. We often find ourselves making suppressed movements to overcome such lack of balance in unsymmetrical figures. Badly proportioned figures produce the same restless feeling in us. Cartoons afford frequent illustrations of both experiences. The ordinary newspaper sketch of a dog will fill the onlooker with a desire to put some prop under the animal's head, so much too large is it for the rest of his body.

The divisions of lines and surfaces disclose similar preferences for one or another arrangement. The golden section is an instance of this type of æsthetic experience. A vertical line is so divided when the larger segment is to the whole as the smaller segment is to the larger. Triangles, parallelograms, circles divided in various ways, and circles compared with ellipses, have all been studied. The positive upshot of these studies thus far is chiefly to indicate the extreme complexity of the conditions upon which these supposedly simple phenomena rest. In general the unpleasant figures produce motor unrest, the pleasant ones motor stability. The one thing means organisation, the other disorganisation. We have found this same fact at every level of affective process; agreeableness tends to the continuation of the agreeable condition, disagreeableness to its change. If our own hypothesis does not contribute very helpfully to the understanding of these particular cases, it at least contains nothing at variance with any of their assured implications.

B. Higher Aesthetic Feelings.—It will only be necessary to add a few lines upon the more developed æsthetic experiences, such as are involved in the appreciation of painting and sculpture. We shall say nothing at this point about the mental attitude of the artist engaged upon his work, although it is here that we must look in the last analysis for a correct impression of the genetic sides of the æsthetic consciousness.

It seems fairly certain that those æsthetic objects which we adjudge agreeable comply with the second of our principles in the moderate stimulation of neural processes which are more than adequate to the demands laid upon them. It seems also to be true that in such cases the third of our principles is justified. An object which we feel to be beautiful sets up ideational reactions which are unimpeded, focalised, and definite. The picture, if it be a picture, means something fairly definite and real to us. On the other hand, pictures which displease or fail to interest us are either unpleasant as regards their colour,—in which case we probably have either inadequate or excessive optical stimulation of some kind,—or they are faulty in drawing, or confused in meaning, so that our minds either feel a discrepancy between what is portrayed and what is suggested, or else are left thwarted and baffled.

The case of music is one in which to most of us, did we but acknowledge the truth, the sensory element, with its immediate rhythmic motor effects, is at a maximum, and the ideational at a minimum. But it seems difficult to find an instance of æsthetic experience which does not readily enough conform to our principles.

It is often said that æsthetic experiences are useless. But this can only be maintained from a narrow and purely physiological point of view; and even there it is not strictly true. On the whole, then, we may accept these principles, provisionally at least, as indicative of the general facts about the conditions for the appearance of affective reactions, and as suggesting their fundamental significance. We shall now go on to see, in connection with our study of instinct, emotion, and volition, how these affective phases of our consciousness actually enter into the determination of our acts and our character. We can in that way make out most clearly the manner in which they enter into the cognitive operations which we have previously discussed.

CHAPTER XV

REFLEX ACTION AND INSTINCT

Motor Aspect of Conscious Processes.—We come now to study the group of motor powers by means of which the organism is enabled to guide its own movements, and so to control in a measure its own fate. In many of the discussions which have gone before it has been necessary to assume that these muscular reactions were occurring, but their intimate nature we have been obliged to overlook. As a matter of fact all the mental operations which we have analysed have their ultimate significance and their final outcome in precisely these motor activities. In reality, therefore, all our previous study has been upon these reactions, for it has all had to do with their immediate psychophysical antecedents, which are functionally a part of them. Nevertheless, it is essential that we should examine the motor phenomena in and of themselves, and much more exhaustively than hitherto. We shall turn, first, to the earliest forms of muscular activity which we find in the human being and then proceed to study the more highly developed forms which characterise a later period.

Primitive Motor Capacities.—A survey of the motor equipment of a new-born babe discloses the fact, as we have previously seen, that a certain number of automatic and reflex coördinations are already provided for at birth. The automatic activities of respiration, circulation, and digestion are carried on from the first. The reflexes involved in sucking, crying, and clasping the fingers about objects placed in them also take place. But aside from these and the occasional random impulsive movements mentioned in chapter III, the child's motor capacities are potential, rather than actual. This slender store of motor accomplishments finds its explanation in the undeveloped condition of the nervous system at birth.

Meagre as is this array of hereditary motor coördinations to which we have referred, it suffices, with parental assistance, to keep the child alive until the appearance of more adequate adjustments. Moreover, it bears striking evidence to the fact, were any demonstration of it necessary, that the human organism is exactly like that of the lower animals, whose instinctive activities are often sources of so much wonder, in that it possesses at birth preformed pathways in the nervous system, by means of which sensory stimulations may discharge in effective movements of accommodation. The primordial form of motor control over the environment is, then, so far as concerns the human infant, to be found in hereditary reflexes.

Early Motor Development.—Development goes forward at such a tremendous rate that it is difficult to follow with entire confidence the course of motor events during the first year or two of a child's life. But certain of the most important transitions from the conditions we have just described occur commonly during the first three or four months, and we may in passing profitably remark upon the general nature of this change. Afterward we shall go back to look for the appearance of other forms of automatic, reflex, and instinctive acts, which we have seen to be the primitive types of motor activity. We shall find evidences of their developments at periods covering a considerable portion of the time of organic growth. Furthermore, we shall find that, in a modified form, the instincts remain throughout life as fundamentally important factors in the evolution of volition and in the foundation of character.

The point to which we wish to call attention for a moment is illustrated by the growth of the hand and eye control. At the outset the eyes are generally destitute of all orderliness of movement. They move independently of one another, and with no special reference to objects in the field of view. In the course of the first few weeks, however, they begin to move together, to converge, and gradually to show a tendency to follow moving objects. At this period the child loses its original blank stare, and from time to time fixates objects with a totally new expression of countenance. About the time that this accomplishment is achieved the hand begins to show a definite development. It explores objects with which it is in contact. The thumb, which at the beginning took little or no part in clasping, is now brought into operation, and the things grasped are moved about in a fairly well coördinated manner. The next step in advance is characteristic of all development in motor control, and consists in the conjoining of the two previously independent coördinations of hand and eye. The eye is now able to follow the hand, and the hand is able to give the eye objects for inspection.

We shall come back with more detail to this type of intercoördination of acquired forms of control in our analysis of voluntary action. Meantime, it will be helpful to bear in mind that once a coördination, like the eye-coördination, is gotten under command, it is promptly incorporated as a member of a larger coördination, such as the eye-hand coördination, which is in its turn destined to a similar fate in the course of evolving conduct. It should be noticed that certain coördinations emerge originally from larger ones before undergoing a secondary process of incorporation such as we have described. The control of the movements of the several fingers *separately* is gotten long after the control of the fingers moving as a whole. Later these separate movements may be combined in elaborate new groups, as in piano playing.

Turning back now to a fuller study of the instinctive and reflex types of action, we shall find the general trend of events to be somewhat as follows: The development of the nervous system goes on with astonishing rapidity during the first three years, so that the child has, with the exception of the sexual processes, practically a full store of reflexes established by the end of that time. Contemporaneous with this acquirement of the reflexes occurs the gradual unfolding of the life of impulse, and the upbuilding of this into the elaborate forms of voluntary action, which promptly tend to become habitual. We must now analyse more carefully the details of this process.

Reflex Action.—A reflex act, as has been earlier remarked, is one in which a muscular movement occurs in immediate response to a sensory stimulation without the interposition of consciousness. Consciousness is often aroused by reflex actions, but the motor reaction is not executed in response to conscious motives, and in the more deeply imbedded reflexes consciousness is quite powerless to suppress the movement. Thus, in winking, we may be conscious that the eyelid has closed, and at times the movement may be executed voluntarily. But if a cinder or other irritating substance enter the eye, we may be wholly unable to resist the tendency to shut the lids. On the other hand, when we are absorbed in reading, our eyelids may close dozens of times in the reflex way, without our becoming in any definite manner aware of the fact.

Variability of Reflexes.—We have already referred many times to the (racially) hereditary nature of these reflexes. It remains to point out certain other striking facts about them. In the first place, they are subject, like all organic activities, to the general principles of development. They appear from time to time, as the nervous centres ripen, and are not all given complete at birth. The more rudimentary of them appear within the first few months. Sneezing, coughing, and hiccoughing come within the first few days, as a rule. Winking comes somewhat later, generally from the seventh to the eleventh week. Walking, which is primarily based upon reflexes, does not ordinarily begin until the twelfth to the eighteenth month or thereabouts, and is generally preceded by the creeping movements, which are probably partially reflex. Moreover, no one of the reflex acts is, at the outset, so well coördinated as it speedily becomes. It is clear that the nervous machinery, like other machinery, requires to be used somewhat before its maximum efficiency is available.

Furthermore, the reflexes vary at times in response to the general conditions of the organism. They are not wholly dependent in their operation upon the presence of a stimulus. The child, for example, when sated, stops sucking. When one is nervously wrought up, a slight noise, if unexpected, may result in a violent movement; whereas, if one had been agreeably absorbed in some occupation, no movement of any noticeable kind would have occurred. On the other hand, the essentially mechanical nature of the reflex is rendered obvious by the impartial way in which such responses are often executed, regardless of the desirability of the act at the moment. A man wishes his presence to be unobserved when in a dangerous situation, and he must needs select that occasion to be seized with an irrepressible paroxysm of sneezing. Again, although one is behind a strong screen, one may find it impossible to avoid winking when any threatening object is seen approaching close to the eyes. It appears, therefore, that whereas the reflexes represent hereditary modifications in the connections of sensory-motor activities,—which are undoubtedly indispensable for the maintenance of organically useful reactions,—they may at times, by virtue of their mechanical nature, react in injudicious ways; and on the other hand, certain of them are unquestionably open to modification, either through the direct control of the mind, as when one succeeds in suppressing a tendency to wink, or through the indirect effect of general organic conditions. It is evident, therefore, that reflexes represent various degrees of plasticity, but this does not invalidate the doctrine that all of them are hereditary in nature, and that on the whole they contribute distinctly to the general efficiency of those adaptive reactions which the organism makes upon its surroundings.

Instincts.—Instincts have an origin unquestionably similar to that of reflexes. They represent structurally preformed pathways in the nervous system, and stand functionally for effective inherited coördinations made in response to environmental demands. It is, perhaps, impossible to draw any absolutely sharp line between instincts and reflexes, although many principles of demarcation have been proposed.

On the whole, the most fertile and suggestive working distinction seems to be found in the presence or absence of some relatively definite, though non-conscious, end dominating a *series* of acts. If the motor activity is simple, and is discharged in response to some objectively present stimulus without conscious guidance, it will be safe to call the act a reflex. Moreover, some reflex acts are essentially unconscious, whereas instincts, in the higher animals at all events, appear always to involve consciousness. Instincts accordingly depend more largely than reflexes upon the operations of the higher brain centres. If the activity involves a number of acts, each one of which, considered singly and alone, is relatively useless, but all of which taken together lead up to some adaptive consequence, such as the building of a nest, the feeding of young, etc., it will be safe to call the action instinctive. The difference thus pointed out is founded theoretically upon the nature of the functions subserved by the two types of action, their relative immediacy, generality, etc. It sometimes appears to reduce in practice to a mere difference of degree, or complexity, and it will generally be found on further examination to involve a difference in the intra-organic conditions leading to the two forms of reaction. Instincts such as mating and nest building in birds depend for their emergence far more upon internal organic changes than do any ordinary reflexes. It must be frankly confessed, however, that many cases are discoverable in which all distinctions seem arbitrary and fictitious. Too much stress should not be laid, therefore, upon the matter of ultimate differences. It is rather upon the identity of service to the organism that the emphasis should fall, with the added recognition that such service may be rendered in thousands of ways, whose interrelations may well baffle our clumsy and ill-informed attempts at classification.

Modifications of Instincts.—Instincts resemble reflexes in their susceptibility to modifications through experience, and also in their appearance in connection with definite stages in the development of the nervous system. Experience operates in two opposite directions. (1) If the first expression of an instinct chances to be disastrous, and results in pain or fright, the instinct may be either temporarily, or permanently, inhibited. Thus, chicks, which possess the instinctive tendency to peck at food, are said to suppress this tendency when bad-tasting food is given them. (2) On the other hand, if the instinctive action is successful and produces agreeable organic results, it tends at once to become ingrained as a habit. In all creatures which possess even rudimentary forms of conscious memory, instincts must, therefore, speedily lose their original and wholly blind character. The tendencies to instinctive reactions must, in such creatures, very early set up organic reminiscences of the previous consequences of their indulgence; and these reminiscent traces must lead either to inhibitory movements or to responses of the habit type, in which the outcome must be in some vague way forecast.

Suppression of Instincts.—Instincts not only appear at definite points in the growth of the nervous system, but certain of them may also atrophy and disappear, provided that at the crucial period the appropriate conditions are not at hand to call them out and fix them as habits. Illustrations of the periodic nature of development in instincts are familiar to everyone. The puppy cannot swim, the older dog can, and he does it instinctively. The bird displays no tendency to nest-building until a certain maturity is attained, and instances of a similar kind might be multiplied indefinitely. The abolition of an instinct by failure to secure expression at the correct time is shown in the case of chickens, which tend at first to follow any moving object. Ordinarily nature provides, of course, that this object shall be the maternal hen. If the opportunity to translate this instinct into a habit is not afforded, the instinct dies within a few days, and thereafter commonly cannot be reëstablished.

Instinct, Experience, and Reason.—The relatively flexible and plastic nature of instincts which is suggested by the foregoing observations finds additional confirmation in the innumerable instances in which intelligence, or unexpected and unusual environment, come in to exercise modifications. In the earlier views of instinct we always find it contrasted with reason, as though the two were radically distinct. The keener insight of our own time shows us that although reason represents the individual's contribution to his own fate in terms of his own experience, while instinct represents the contribution of racial experience, the actual operation of the two factors often displays most intimate inter-relations. This is peculiarly true of all the higher animals, and especially man. Indeed, the great difficulty in studying instinct in human beings is due to the fact that intelligence immediately comes in to transform the native reactions in accordance with the dictates of the individual's personal experience.

Even in the lower animals, however, individual experience exercises a guiding influence over the particular forms of instinctive expression, although in many of these cases we must speak very conservatively as to the manner and measure in which consciousness participates. Whatever the explanation of the *modus operandi,* there can be no doubt that birds and insects such as bees and wasps and ants often modify their instinctive methods of nest-building in a most remarkable manner when the exigencies of local conditions require such modification. The instinctive tendency is *general* and not *specific.* Many different things may elicit its expression. It may thus be easily fitted into variations in environment. On the other hand, instincts are often carried out in a bungling fashion, and in the face of circumstances clearly fatal to their successful issue. The well-known disposition of certain dogs and squirrels to attempt, with elaborate efforts at digging, the burying of their bones or nuts when confined upon hard board floors illustrates the occasional futility of irrepressible instincts. The classical observations of the Peckhams upon bees and wasps afford striking instances of instincts misdirected at some crucial moment. They report, for instance, that wasps frequently prepare a nest carefully for the reception of the food store and then seal it up empty.

The obvious implication of such observations is that we have to do in the phenomena of instinct, as these appear in the several genera and species of the organic kingdom, with an overwhelming variety of reactions, all of which evidently emanate from the same type of ancestral source; but with indefinite and unpredictable susceptibility to modifications from environing conditions, and with an equally uncertain submission to conscious guidance. In so highly evolved a nervous system as that possessed by the human being we may naturally anticipate a very considerable number of these ancestral tendencies, and we must also expect to find them very promptly submerged in motor activities under the control of the mind. These expectations seem to be fully realised by the actual facts.

Origin of Instincts.—Although everyone is agreed that instincts are racial habits transmitted by heredity to the particular individual, there has been wide difference of opinion regarding the precise manner in which they originally became established. The questions here at issue are clearly in large part biological in nature, and this is, therefore, evidently the reason why we find that the authoritative names connected with the conspicuous theories are chiefly those of great naturalists. Two fundamentally opposing views have until recently held the field. One is commonly known as the theory of *lapsed intelligence.* The American biologist, Cope, was an eminent defender of this view, which regards instincts as organically fixed habits which were originally intelligent adaptive acts partaking of the general character of volition. Wundt has been a distinguished adherent of this view among psychologists. The second theory is known as the *reflex theory,* and its basal contention is that instincts are simply accumulated reflex adjustments, explicable in their survival by the general principle of natural selection, which tends to weed out accumulations, however acquired, which are not preservative in their effect. Spencer and Weismann are representative adherents of two sub-forms of this theory.

The first theory has been criticised as making too great demands on our credulity concerning the amount of intelligence displayed by primitive forms of organisms, and also on the score of defective evidence for the transmission of acquired characteristics. The second theory has been held vulnerable in its inability to explain how groups of reflex movements could have been slowly built up, when only the final step in the process rendered the chain really useful. A recent modification of these views, for which J. M. Baldwin stands sponsor among psychologists, is known as the theory of organic selection.

Theory of Organic Selection.*—The crucial point in this theory is the supposition that even tentative and imperfect acts of accommodation, with or without conscious direction, may serve to preserve the life of a species during the critical period when an instinct in its entirety is forming, and thus give it opportunity to become permanently imbedded in the organism as both a structural and functional attribute. This position recognises the fact that a complex instinct may require a considerable time and many generations to become firmly ingrained; and that during the period when this fixation is in progress the organism may need assistance in coping with its enemies. Such assistance may emanate from conscious processes or from chance physiological accommodatory actions. In either case the life of the species would be conserved during the period when the instinct was in process of formation. An instinct may thus *indirectly* involve conscious activities in its establishment, although it does not arise from the direct crystallisation into habits of previously conscious acts. Whether this view succeeds in weathering the storms of criticism or not, it is at least a highly ingenious and suggestive modification of the two previously extant views. It seems to contain what was most significant in both, while avoiding the more obvious pitfalls belonging to each. It gives scope for the play of intelligence in assisting in the formation of useful reactions, without going to the indefensible extreme of assuming that all valuable coördinations have such intelligent origin. On the other hand, it offers a practicable hypothesis as to the manner in which movements of essentially

*The term "organic selection" is used in antithesis to the older term "natural selection." Natural selection is generally interpreted as affecting the preservation or destruction of *entire organisms.* Organic selection applies to the specific accommodatory *acts,* which an organism may execute in the effort to meet the exigencies of its environment. By selecting one type of action rather than another, it may succeed in surviving and leaving off-spring.

reflex character may have become chained together in instinctive reactions.

Function of Instinct.—Despite the differences which have characterised the opinions of the most acute biologists as to the origin of instincts, there is no divergence of opinion as to their function. They represent, by common consent, those forms of reaction upon the environment which the race has found most effective in maintaining itself against the rigours of climate and geographical habitat, and against the assaults of various forms of animal life. So far, therefore, as we find traces of true instincts in human beings, we may know that we are confronted with tendencies which represent racial experiences, with reactions which express the pressure of untold ages of man, or his pre-human ancestors, engaged in the struggle for existence. It should, in the light of such considerations, afford us no astonishment to find that some reactions have been preserved, which are either useless at present or even somewhat positively disadvantageous. Moreover, remembering the complex conditions of our organic structure, we may well expect that certain of these instinctive reactions may possess their chief value and significance in the intra-organic physiological changes which they bring about, rather than in movements primarily affecting objects in the environment. Both these anticipations we shall find fulfilled.

CHAPTER XVI

THE IMPORTANT HUMAN INSTINCTS

The Distinction Between Native and Acquired Forms of Reaction.—We come now to examine the general scope and character of human instincts, and we are at once confronted with the concrete difficulties previously mentioned, *i. e.,* the difficulty of distinguishing the genuinely instinctive and hereditary reactions from the merely habitual, or from the acquired. Fortunately, there are certain great basal instinctive activities which we find appearing in children long *before they have had sufficient experience to enable them to execute such reactions on the basis of volition;* and, furthermore, there is a considerable group of reactions which all of us manifest, that appeal to us when our attention is called to the matter as being native and untutored; as all but wholly devoid of purposeful conscious guidance. With these as a clue we may at least make a begining in our catalogue, and from their analysis secure hints as to other similar instinctive traits.

In all properly constituted babies anger and fear are in evidence, with their appropriate motor expressions, long before experience has afforded opportunity to observe and copy these reactions in others. They are, therefore, unquestionably native. It may, however, be said, that these are emotional processes, and not instincts. Half of this contention is true and half is false. Anger and fear *are* instincts and they are *also* emotions. Each involves a series of somewhat elaborate organic activities, and these are all of the unpremeditated hereditary type. They possess, however, in addition to these motor characteristics, perfectly definite conscious concomitants, and to the *conscious* part of the whole process we commonly give the name emotion. We shall return to a detailed consideration of emotions in the next chapter. Meantime, we find that in anger the brows are wrinkled, the face ordinarily crimson, the veins gorged and prominent, the nostrils dilated, the lips drawn back and the teeth set, the hands clenched, the body tense, and the voice harsh. In extreme fear we meet with pallor and trembling, spasm of the heart, diarrhœa, the appearance of goose-flesh, cold sweat, bristling of the hair, dryness of the mouth, choking, paralysis of the voice, or hoarse screaming, together with tendencies to flight, coupled with a feeling of weakness. These reactions are called out precisely as are the instinctive reactions in animals, *i. e.*, by the presence of appropriate stimuli. So far as consciousness is involved in them, the striking thing is the headlong fashion in which we find ourselves plunged into a vortex of intense impulsive feeling compelling us to acts the consequences of which, in their first expressions, at least, are wholly unforseen.

Utility of Instinctive Reactions.—The utility of such expressions may well arouse one's curiosity. In the case of anger some of the movements evidently have a "use" value, provided actual combat is necessary or desirable. But the trembling of fear, whatever may be said of the tendencies to flight, is a questionable organic asset for an individual wishing to react most effectively upon menacing surroundings. It must be admitted frankly that some of the motor responses displayed in emotional and instinctive discharges are unintelligible at present from the standpoint of utility. The attempt has often been made to refer the preservation of such acts as have no obvious value for the conquest of the environment, and even, perhaps, a deleterious influence upon this task, to their *physiological* usefulness in restoring disturbed organic conditions. Thus, the gorging of the blood vessels in anger, the secretion of tears in grief, laughter in response to wit and humour, have sometimes been held to assist in relieving the abnormal circulatory conditions in the brain set up by the several emotional experiences. It may well be that these reactions represent merely the inevitable drainage into available channels of excessive motor excitation. Such a supposition would account for their variability in different individuals, and in the same individual at different times. For example, some persons show anger by growing red in the face, others grow pale. Of all such explanations one can only say that they serve, at least temporarily, decently to cloak our ignorance. Nevertheless, there seems to be in the meantime no hesitation in any important quarter in accepting the general hypothesis already mentioned, that these racial habits which we designate emotions and instincts represent types of reaction which were useful at some time in the past history of the race, however problematical their usefulness may be at present.

Genetic Inter-relations of Instincts.—The precise order in which the great mass of instincts make their debut is a difficult problem, and one for which it is, perhaps, not altogether profitable to undertake a solution. It seems probable that rudimentary forms of most of the instincts are encountered at a very early date, whereas the occasion for the expression of the matured reaction may be long postponed. Ribot has made it clear that in general those instinctive activities, such as fear and anger, which have to do most immediately with the maintenance of the physiological organism, and to which he gives the name of "egotistical emotions," are the first to appear in infancy and the last to disappear in old age or before the ravages of mental disease. The more altruistic emotions and instincts are for the most part found in a developed condition much later. Thus, sympathy, in unequivocal form, anyhow, occurs only with some considerable mental development. Indeed, it has sometimes been questioned whether sympathy is truly instinctive at all; whether it does not rather reflect the conclusions of intelligent consideration. But on the whole there seems no good reason to cavil at the evidences of its native character, especially as we can discern its seeming presence in certain animals.

List of Human Instincts.—Waiving, then, the question of the order of appearance, we find the generally recognised instincts in man to be as follows: Fear, anger, shyness, curiosity, affection, sexual love, jealousy and envy, rivalry, sociability, sympathy, modesty (?), play, imitation, constructiveness, secretiveness, and acquisitiveness.

Many authorities would add hunting to this list, and it must be admitted that in many races, and in many individuals of all races, it gives strong indications of a fundamentally instinctive nature. It is, however, so honeycombed with the effects of experience, and so irregular in its appearance, that it may fairly be given a position among the disintegrating instincts. Walking and talking are also included by many writers. Whether they shall be counted in or not is, as we have already observed, simply a question of classification. We may call them either chained reflexes or instincts, according to the criterion which we adopt for our divisions. James has added cleanliness to his list, and there are some facts which point to the correctness of this view, both in its application to men and to animals. But it is at best a very imperfect and erratic trait, as any mother of normal children can testify, and we may omit it in consideration of the necessary brevity of our discussion. We shall similarly forego any description of sympathy and modesty. Nor shall we attempt to catalogue the vast array of *rudimentary* instincts which lead psychologists to assert that man has more instincts than any of the animals. A baby will do more things in an essentially instinctive way with an object put into his hand than will any animal. He will turn it about, put it in his mouth, drop it, pick it up again, stroke it, hammer with it, and so on *ad libitum*.

A perusal of our list brings at once to notice the union of instinct and emotion. A part of the terms apply primarily to *acts,* and so connect themselves with the common implication of the term instinct; whereas the other part suggests much more immediately the conscious feelings characteristic of the several forms of emotional experience. Imitation, play, and constructiveness are examples of the first kind of term; fear, anger, and jealousy illustrate the second. A few comments upon each of the instincts mentioned may serve to emphasise helpfully the typical conditions under which they appear, and the wholly naïve, untutored nature of the motor reactions which they manifest.

Fear.—We have already sufficiently described the motor phenomena in the case of fear, and it surely requires no additional argument to convince one of their native and unsophisticated character. It only remains to notice that in little children, despite some irregularity in different individuals, the normal provocatives are represented by strange objects, frequently by fur, by strange places, and especially by strange people, by being left alone, by darkness, and even occasionally by black objects; and by noises, particularly if very loud and unfamiliar. In later life, in addition to the fear which arises from the presence of actually dangerous situations, such as the menace of a great conflagration, many persons are seized with dizziness and a more or less acute terror upon finding themselves on a very high place, even though the possibility of falling over is efficiently precluded by railings, etc. Others are frightened by anything which verges upon the supernatural. Even the cold-blooded materialist of polite fiction feels his unsentimental blood curdle just a bit at the rehearsal of a thrilling ghost story, and only the possessor of practiced nerves can be alone on a dark night in a cemetery, or a thick wood, without some "creepiness" of the hair and skin.

All of us are likely to find that in the midst of a violent tempest, whether on land or sea, the howling of the wind is a distinct source of mental anxiety quite disproportionate to our sober, intellectual apprehension of its real danger. Thunder and lightning are for many persons sources of irrepressible terror. All these things take hold of our racial instincts, and however vigorously our individual experience attempts through its cortical machinery to put a veto on such nonsense, our lower brain centres refuse to abandon their world-old habits, and accordingly we find that our hearts are beating wildly, our breathing coming in gulps, our limbs trembling, the while we look on, mortified at the weakness we cannot control.

Anger.—Anger has several different forms and the most varied provocatives. We are irritated by the tireless piano next door, exasperated by the teasing child, hurt and vexed by the social snub, angry at the open insult, and perhaps moved to enduring hatred by the obnoxious and unscrupulous enemy. There is a common emotional vein running through all these conditions however much the particular momentary expression may vary. Possibly resentment is the best name wherewith to label this common factor. The instinctive nature of the motor reactions requires no further demonstration than is furnished by the sight of any little child enjoying a tantrum. The explicitly pugnacious element is, under civilised surroundings, inconspicuous after childhood is passed, despite the tremendous virility it displays if the curb be once slackened. The evolution of the race has been notoriously sanguinary, and we should feel no surprise, however much of disgust and regret we may entertain, that under the excitement of actual combat the old brute should display the cloven hoof. The development of so-called civilised codes of war affords interesting instances of the effort rational man makes to clothe with decency the shame of his own brutishness. According to the prevailing code, women and children may not be slaughtered, but it is occasionally lawful to despoil them of their flocks and herds, to lay waste their grain, and even to burn the roofs above their heads.

Shyness and Sociability.—The antagonistic instincts to which we have given the names shyness and sociability, not only appear as genuine hereditary impulses in little children, but they also fight, in the case of many persons, a lifelong battle for supremacy over the individual's habits. Sociability is simply an expression of the essentially gregarious nature of man. Some men seem destined for membership in a very small herd,—two or three at most,—others find their most natural surroundings amid large numbers. But the man or child who in one form or another does not natively crave companionship, sympathy, admiration, and confidence from others is essentially insane. Many turn from life and such companions as they chance to have attracted with horror and disgust, seeking in God or in some ideal of their own imagination a companionship which shall be fit and satisfying. But what is such a turning other than the most pathetic appeal for true comradeship, for a real society comformable with the deepest needs of the soul? No, sociability, under whatever limitations, is an expression of the very essence of humanity, and every little child evinces it by shunning solitude.

What often passes with children for a love of solitude is really more truly referable to the operation of the contrary instinct of shyness. In the very nature of the case the two impulses must always have been in unstable equilibrium so long as the drama of human life has been upon the boards. A certain measure of suspicion toward the action and purposes of others must always have been a condition of avoiding harm and imposition. On the other hand, the race is fundamentally gregarious, and all its greatest achievements have come about through coöperative undertakings in which the solidarity of the social structure has been a *sine qua non*. The tension between these two instincts, which we often find existing in ourselves, is no mere idiosyncrasy of our own purely personal organisation. It is rather a replica in us of a conflict which has been a part of the experience of every sane human being that ever lived.

Sociability finds everywhere its natural expression in smiling and in bodily attitudes, or gestures, which are, perhaps, best described as obviously non-pugnacious. The secondary gestures, apart from smiling and laughing, are through imitation early overlaid with the conventional ceremonials of different races and peoples. But in babies we find general extensor movements of reaching and stretching out of the arms, with eyes wide open and gaze fixed, head erect, and often nodding. In shyness the precise reverse is encountered. The eyes are averted, the hands and arms held close to the body, the whole attitude being one of retreat. In older children and adults blushing and stammering, or even speechlessness, are common concomitants. Strangers and persons feared or venerated are the normal stimulants to shyness. In both kinds of reaction the movements are observed before there can be any question of conscious imitation. They are accordingly of undoubtedly instinctive nature. The great difficulty many persons experience in inhibiting the expressions of shyness also points to a similar conclusion.

A special form of the generic tendency to sociability is found in childish affection for parent or nurse, and in the tender feelings in general which we cherish toward those of whom we are fond. It finds its overt manifestation in facial expression, in modulation of voice, and in caressing gestures in general. The instinct is speedily veiled by experiential influences, but it gives every internal evidence of resting upon a native impulse, and its motor indices apparently require no artificial training. In childhood its common stimulus is found in persons upon whom we are dependent for our daily care. It may even extend in a somewhat imperious fashion to toys and other possessions intimately associated with childisb cosmology. In mature life its stimulus is extremely complex, and baffles brevity of description. In general, it extends to all persons and possessions that we cherish as in some sort a part of ourselves.

Curiosity and Secretiveness.—Curiosity and secretiveness are in a measure antithetic impulses, like shyness and sociability; they vary immensely in different individuals, but bear, whenever met with, unmistakable traces of an instinctive origin. Animals afford us abundant instances of curiosity, and many methods of hunting are designed to take advantage of this tendency. Taken broadly, curiosity is simply another name for interest. In its simplest and most immediate form it is represented in the vertiginous fascination which novelty of any kind at times possesses for us. The child must pry about until he has fathomed the depths of your preoccupation. If asked why he wishes to know what you are about, he could give you no rational answer, even if he would. He obeys his *impulse,* and to ask for any deeper reason is itself unreasonable. The staid business man who allows himself to be lured across the street of a summer evening by the flaring torch of the street fakir has no reputable account to offer of his procedure. Time out of mind he has yielded to the same fascinating bait, always to find the same old bogus gold watches, the same improbable jewelry, the same nauseous medicines, passing out into the capacious maw of the great gullible public. Curiosity is the racial instinct to which our sedate citizen is yielding, and that is all there is to the matter. In this simple form the motor expression is found in the alert and wide-open eyes, the parted lips, the attentive ear, the general attitude of readiness to react to any lead. In its more intellectual phases we shall consider it under the head of interest in a later chapter.

Secretiveness will by many readers be thought unwarrantedly introduced as an instinct. It is not usually of sufficient consequence to justify any extended defence of its instinctive nature. But as a special form of shyness, at least, it deserves a word. It seems to be a development of those instincts among animals which lead them to render themselves as inconspicuous as possible. Certain insects and birds frequent haunts in which the surroundings, whether vegetation or earth, are of a colour similar to their own. In a corresponding fashion many persons feel an ineradicable impulse to conceal their plans, their actions, and their character behind a screen of non-committal silence and reserve. The impulse has no necessary connection with the preservation of a consciously defined personal dignity. It extends quite as forcefully to the suppression of all publicity touching the trivial as it does to the concealment of the momentous. Taciturnity is its commonest expression—if this formulation be not itself a paradox. Its irrational impulsive character is the mark which stamps it instinctive. Many of us are at times secretive of fixed and consciously recognised design. But the sort of thing of which we are here speaking is temperamental and may be felt in the absence of all explicit justification.

Acquisitiveness.—The instinct which we have called acquisitiveness appears chameleon-wise in many colours and under various conditions. Perhaps its ancestral origin is to be found in the storing habits of animals. As a primitive expression of the recognition of personal property it is one of the earliest and most tempestuous of innate reactions. It commonly gets a bad name at this time, and is often undiscriminatingly entitled selfishness. Certainly the distinction between *meum* and *tuum* is one for which every child betrays a remarkable precocity, although the precocity is commonly much more evident in the emphasising of meum than in the recognition of tuum. But however perverted the moral perspective, the thing is there in the form of an impulse to get hold of, and keep, and guard, something—anything. The particular objects which call it out are altogether incidental to the momentary surroundings and to the age of the special individual. With boys in the "marble age" "glassies" and "alleys" are the recipients of the passion. A little later it may be ribbons bestowed by, or purloined from, the young ladies of the hour; presently it is stocks and bonds and real estate. Now these things are many of them sought for ulterior ends consciously apprehended. But through the whole drama runs the instinctive thread, the tendency to acquisition, binding the whole together into a vital tale of human impulse striving after gratification. So far as it can be said to possess relatively fixed expressions, they are to be found in the elaboration of the infantile reaching and grasping, with the facial expression of alert, tense interest, and the intra-organic disturbances which generally accompany such excitement. The impulse takes its origin, however, from so many forms of stimulations that a perfectly fixed and inflexible motor indication of it is hardly to be expected. Kleptomania is perhaps a perverted and diseased form of the instinct.

Rivalry.—Closely connected with acquisitiveness is the instinct of rivalry, or emulation. It is intimately allied to play and imitation in its origin, and it easily runs to excess in anger, hate, jealousy, and envy. Its stimulus is apparently found in the successful achievements of anyone coming within our own social circle, by virtue of which we are likely to be relegated to inferior positions. If one happens to be a bank clerk, one feels no rivalry instigated by the promotion of the janitor, but the advancement of one's fellow clerk is quite another matter.

The small boy views with unmixed admiration the skill of the profesional ball-player, but the performances of his rival for a place on the school nine stir his blood in quite a different way. So far as concerns the voluntary muscles, the expression of this impulse has about it hardly anything fixed save the vigour and energy which go into their use when stung by the prick of rivalry.

As we intimated a few lines above, emulation is readily transformed into anger, and this fact points to a kinship which has undoubtedly in the history of racial evolution been most significant. Among the lower animals fighting is a constant and fundamental factor in life history. Under the ameliorating conditions of civilisation mankind has managed in large measure either to eliminate this element from human life, or so to change its complexion as to shade its more brutal features, and to substitute for bloodshed and carnage the starvation and bankruptcy which emanates from unsuccessful competition. In so far, therefore, as rivalry represents the survival in modern life of the old fighting propensities, we must look in it for the vestigial evidences of tumult and excitement, of emotional tension, which have always characterised the struggle for existence. Needless to say, we find them in abundance, and hence it is that emulation so easily leads to the more unworthy instinctive expressions; hence it is that so much of moral dignity attaches to him who can feel and cherish rivalry, without sacrificing his highest ethical ideals of integrity and respect for others.

Jealousy and Envy.—Viewed merely as natural impulses, jealousy and envy are sufficiently alike to render a separate mention of each unnecessary. Envy is generally applied to our covetousness of the prosperity or possessions of others. This covetousness is often accompanied, as in jealousy, by more or less malignity. Jealousy we commonly apply to a similar feeling toward persons who are our supposed rivals, whether actually successful or simply feared. Both animals and little children manifest jealousy, and no one can question that the *depth* of the feeling, together with these facts, points to its springing from a racially hereditary source. Its characteristic expressions are similar to those of anger and hatred, but commonly occur in milder form.

Sexual Instincts.—Among the most imperious of our impulses are undoubtedly those connected with sex. The approach to sexual maturity is usually attended by very deep-seated organic changes, and these are reflected in a marked development of the whole emotional nature. It is in this fact that we find an explanation of the definite bent which is often imparted to character at this time, leading in certain instances to a life-long devotion to ideals which are lofty and habits which are pure, and in other instances to perversion and debasement of the entire moral nature. This is *the* great formative period, the storm and stress period, of the moral life. The delineation of the basal facts in the birth and development of love between the sexes has been accomplished so perfectly in the great poems and tales of passion as to render futile and superfluous any such brief outline as would be possible here.

Parental Love.—Parental love is a far stronger impulse in the mother than in the father, as a rule. It is unquestionably instinctive in the mother, is given most lavishly during the infancy and childhood of the offspring, but commonly remains to the end one of the majestic forces in the history of humanity. Its expressions are partly those of caressing tenderness and partly those of protection and prescient regard for the needs of the child.

Play.—We come now to speak of the three instincts remaining upon our list, *i. e.*, play, imitation, and constructiveness. They are by no means synonymous, but their connection is so intimate, and their significance for the development of the child so similar and so important, that we shall consider them together, and at some length. Moreover, they illustrate peculiarly well certain characteristics of instinct to which attention was called in the previous chapter. They are *general* and *not specific,* both as regards the stimuli which elicit them, and as regards the motor reactions which they manifest. We should therefore be more accurate, perhaps, were we to speak of instincts of imitation (using the plural rather than the singular), instincts of play and so on.

The same qualification might well be applied in connection with several of the instincts which we have already discussed. But despite this wide variation in the circumstances of the reactions, we must not under-rate their genuinely native character. Instinctive acts represent a transition from the most fixed and mechanical of reflexes on the one hand, to the fluid conditions of voluntary acts on the other. Certain instincts approach one of these extremes, others approach the opposite extreme.

In little children the impulse to play is practically identical with the impulse to use the voluntary muscles. Indeed, the definition of play which enjoys widest currency at the present moment identifies it with the free, pleasurable, and spontaneous activity of the voluntary muscles. For all periods after those of early childhood, say subsequent to seven years of age, there is an increasing disposition to contrast play with work, and to ascribe to the former a certain lack of seriousness. But with little children this lack of seriousness exists only for the sophisticated onlooker. To the child himself his playing is the "real thing." It has all the seriousness which the child is able to reflect in his activities at the time.

The two most important theories regarding play are, perhaps, those advocated respectively by Spencer and Groos. The former regards play as representing a discharge of surplus organic energy. The latter considers it as an impulsive function serving to call into being those activities which presently are to be required in the strenuous conflicts of life. Play has its biological significance, therefore, in the discipline which it affords. So far from finding it necessary to choose one or the other of these theories, reflection suggests that they are entirely reconcilable and distinctly supplementary to one another. It may be that the impulse to play has its racial significance in the opportunity which it affords for the exercise of those forms of coördinated movement which adult life demands. It may, indeed, owe its preservation in hereditary form to just this circumstance. And it may, nevertheless, be also true that in its expression at any specific time the impulse really represents the tapping of reservoirs of surplus energy. Both of these explanations seem altogether probable, and they serve to connect the obvious present vitality and utility of the play impulse with adequate genetic and historical causes.

Imitation.—As the play impulse actually is observed in its development, it early takes on certain imitative characteristics, and at a slightly later date, perhaps, gives evidence of deserving the name constructive. As in the case of play, we must distinguish several stages or phases in the imitative reactions. There is without much question a purely instinctive form of imitation in which, without any necessary conscious purpose to imitate, acts of others are repeated as accurately as possible. This is conspicuously true of the earlier speech activities, in which the sensations of the vocal sounds made by others seem to discharge immediately, in an almost reflex manner, in articulatory reactions more or less closely resembling the stimulus. At a later period, however, there is a definitely conscious purpose to repeat sounds, and this kind of conscious imitation characterises a large part of the educational process in young children. Indeed, the only propriety in mentioning it in this chapter, so explicitly volitional is it, arises, first, from its possession of a *compelling fascination* for the minds of all normal children, and, second, from its striking similarity to the genuinely instinctive form mentioned above. The name "suggestive imitation" has been given to such acts as appear imitative to an observer but are not necessarily felt to be so by the imitator. A recrudescence of the more purely instinctive type is exhibited in the loss of individual initiative and inhibition in the case of mob action and the movement of crowds, where one falls in, almost unaware, with the purposes and impulses of the mass. "Plastic imitation" has been suggested as a distinguishing name for this class of cases.

Constructiveness.—In childhood constructiveness is hardly more than a convenient term to specify one of the aspects of play. Children delight in the making of things out of their toys, and this may properly be called constructiveness, even in those cases where a carping parental economy might describe the impulse as one of destructiveness. Pulling a feather-duster to pieces to make a nursery Indian may not commend itself highly to the presiding guardian as an evidence of constructive tendencies, but psychologically it is quite as truly entitled to rank here as the activity by means of which the precocious child converts the paternal cigar-box into the inlaid maternal glove-box. Its shortcomings as a constructive performance are ethical and economic, not psychological. In later adult life constructiveness, so far as it is separable from volitional activities exercised under the stress of fear, pride, or other similar emotions, becomes intimately connected with the impulses of artisanship and craftsmanship, in which a native intellectual interest finds a congenial and appropriate channel of expression by means of inborn deftness in specific forms of manual manipulation. This later type undoubtedly has in it much that is genuinely impulsive, but it is so overlaid with the effects of experience that it will not be profitable for us to dwell longer upon it.

Relation of Play, Imitation, and Constructiveness.—It surely requires no complicated demonstration to prove that these three last-mentioned impulses—play, imitation, and constructiveness—interlace with one another in almost inextricable ways. Much of the strictly impulsive element in constructiveness, if not, indeed, all of it, is play, pure and simple. Many of the plays of children, commonly so recognised, are of a distinctly constructive character. The child building a house from his blocks is, from his own point of view, much more truly described as engaged in construction than as engaged in play. The conscious "make-believe" of many plays, and the simulation of fictitious situations, is seldom obvious in the *earlier* plays of little children. Imitation is often simply a designation for a specific mode of reaction which the special play calls forth, and many games have their point in feats of imitation. Constructive impulses are more often than not dependent for their expression in the first instance upon patterns which determine the mould in which the child casts his activities. Little children running after larger children, they know not why, the boy trying to use a hammer as he has seen his father do, the girl playing at setting the table as she has seen her mother do—these and a hundred other instances illustrative of these points will immediately come to mind. We shall revert to the development of these native modes of reaction in our account of the growth of volitional control. It must suffice here to have pointed out the native organic nature of these expressions. The occasions for their appearance are evidently found wherever a situation affords opportunity for a vigorous organism to react spontaneously and agreeably with movements indicative of control and power.

CHAPTER XVII

NATURE OF IMPULSE

Throughout the whole of the preceding chapter, so far as we have dealt with facts of consciousness, we have had constantly before our notice impulses of one or another kind. Impulse is, then, from the psychologist's standpoint unquestionably the cardinal fact about instincts. The residuum is a matter of physiology and biology. It is a mere matter of neural mechanisms. But so far as we have impulse we have a definite psychical factor, and we must examine it somewhat more intimately.

Impulse and Movement.—In ordinary usage impulse is set over against deliberation. To act impulsively is to act on the spur of the moment and without reflection. We shall discover as we proceed that voluntary action consists in bringing order into our impulses and in this sense the antithesis between impulse and deliberate volition is well grounded. But there are other aspects of the matter not suggested clearly by this account.

Etymologically considered, an impulse is anything which "pushes along." We have repeatedly observed the tendency of all forms of consciousness to pass over into movements, and there can be no doubt that in this sense at least all states of consciousness are naturally impulsive in character. Left to itself, any mental condition would convert itself at once into some kind of muscular movement. This is peculiarly true of emotions and of direct sensory impressions, which, as we saw in the chapters on sensation and attention, tend, so far as we give them undivided attention, to set up immediate motor responses. It is, however, equally true of images and other centrally aroused psychoses, so far as we become absorbingly attentive to them. If we have reference, then, primarily to the *consequences* which follow upon mental states, there seems to be no obvious exception to the rule that they all tend toward muscular movements, and are, therefore, all intrinsically impulsive.

This fact must not, however, be interpreted as meaning that all states of mind reveal these motor consequences in equal measure, nor that the impulsive element in them is insusceptible of further analysis. Quite the contrary. The disposition to make certain movements is much more marked in cases of anger than in cases of reluctant choice after deliberation. Moreover, the whole psychosis in anger may be much more intense than in the other case, and we may, therefore, be much more vividly aware of these tendencies. It is evident, consequently, that, viewing the matter introspectively, we have to recognise the existence of very different degrees of impulsiveness in our immediate feelings of disposition to movement. The feeling may be very distinct and acute, as it often is in emotion, or, as in many ideational processes, it may be so faint and insignificant as to have hardly any existence save the hypothetical one to which our whole observation of conscious operations has committed us.

Development of Hereditary Impulse.—Furthermore, we shall at once remark another important distinction if we note the changes accruing from the development of the individual's experience. The first time that one of the strong *racial* impulses is felt, the individual's consciousness contains little or no anticipation of what is about to occur. He is simply aware of an unusual thrill, a passing unrest, which comes to him disclosed in part by muscular movements—half mechanical in their nature. But the inner meaning of his experience is at the moment, perhaps, wholly problematic to him. He is a stranger to himself. How true to the facts this statement is many persons will readily admit by recalling some of the strange, acute mental disturbances of their own adolescent period. The child screaming with fright for the first time is likely to harbour no little shame over the event afterward because of its startling strangeness to him. The youth smitten with his first infatuation is a constant source of wonder to himself. He has become suddenly aware of a multitude of feelings which before were inexistent for him. But all these impulses, once they have been experienced, are thereby forever changed. They may retain, as many of them do, a prodigious intensity and vitality, but thenceforth they have lost a part of their mystery. We know at least so much of what they mean as to anticipate the *acts* to which they tend to lead. From this time forth we become increasingly aware of the *objects* which are calling them into being and of the consequences to which they lead. The impulses tend, therefore, to become more and more sophisticated. They become illuminated with a knowledge of their meaning, and the immediacy of our feeling and our unrestrained disposition to reaction are lost forever after the original, unsullied reaction. The conscious portion of the instinctive life is modified by growth and experience quite as truly as the purely motor and physiological parts of it.*

Consciousness of Impulse.—Impulse as a mental affair may be defined broadly as *the consciousness of tendency to movement.* The disposition to movement is instigated by some stimulus and of this, too, we are aware in the impulse, although we may know little or nothing about the object, as occurs in primary emotional experiences. On the other hand we may be aware in the impulse not only of the tendency to move and of the object calling out the tendency, but also

* Certain authorities prefer to apply the term "instinct feeling" instead of impulse to these racial impulsions. This enables them to confine the term impulse to instances of sensory or ideational motor excitement other than those of racial origin.

of the result to be anticipated from our reaction. Impulse thus necessarily covers many conditions which differ from one another somewhat in complexity.

Even though we admit impulse as a feature characterising all forms of mental activity, we have also to acknowledge very different degrees in its *intensity* and complexity, and very different *conditions* surrounding its expression. We may observe a further similar peculiarity belonging to those reactions which we most commonly regard as instinctive. We may call the play impulse definitely instinctive, and so give it rank among those expressions of our motor dispositions of which we are most keenly and unambiguously conscious. But it requires no elaborate demonstration to prove that we are most distinctly cognisant of the impulsive nature of this reaction when for any reason its expression is *hampered or checked.* Moreover, a little observation would bring the conviction that this is a general principle applicable all along the line. We can hardly be said to be *conscious of* the impulse, as an impulse, if the conditions are all ripe for its immediate translation into movement. Under such conditions we are absorbed in the object of our doing, in the *act,* in the consequences, with their thousand ramifications. But the *impulse* to act, as such, we are hardly aware of in any genuine sense, unless something impedes the impulsive movement. Then we promptly become aware of tense muscles, of thwarted execution. Then we are really *conscious* of the impulse, and we are made conscious of it by means of the nascent and incipient movements to which it has actually given rise.*

As a matter of fact, few of our impulsive tendencies ever find the opportunity to run wholly free and unconstrained. But so far as they do, we find we have lost consciousness of the impulse, as such. We encounter no exception at this

* If the reality of "innervation feelings" could be demonstrated (*i. e.*, consciousness of out-going motor neural energy), our impulses would doubtless prove to be largely made up of such elements.

juncture, then, to the facts which we have in the earlier part of the book so often emphasised, *i. e.,* the fact that consciousness appears at those points where there is friction of one kind or another in the purely physiological mechanisms of adjustment.

Classification of Impulses.—Impulses have been classified in various ways. Titchener, for instance, groups them as impulses toward, and impulses away from, objects; also as individual, or subjective, and social, or objective. The feeding impulses illustrate subjective impulses toward, the defensive impulses exemplify the subjective impulses away from, objects. He recognises three levels of objective impulse: (1) sexual impulses, attraction and repulsion; (2) parental impulses, affection and exclusion; and (3) tribal impulses, friendliness and hostility. Evidently these classifications over-lap in the most intricate manner and can be valued only for their general suggestiveness.

Impulse as Hereditary and as Individual.—It remains to comment upon an extremely important distinction among the various forms of impulse already indicated in the previous chapter. Certain of these seem to be practically invariable in their appearance in all human beings, and they show themselves in the shape of relatively fixed forms of movement. These are the instinctive reactions in the strictest sense of the phrase. In this category belong such activities as fear and anger. Certain other impulses are essentially universal but still somewhat less uniform in their appearance than the preceding class. These impulses have a far more variable form of expression. Here belong the reactions we call play, imitation in certain forms, parental love, etc. Both these classes of impulses give every evidence of a racial origin. But the first type is evidently the more stable and more deeply impressed upon the organism. Over against these two classes of impulsive acts—of which the first are more justly designated instincts, although both groups express the pressure of racial experience—are to be set the residual conscious activities, sensations, ideas, judgments, feelings, which are all impulsive, as we have seen, in the sense in which this indicates their relation to movement. These latter forms of consciousness are, however, representative of the processes by means of which, on the foundation of his racial patrimony, the individual builds up *his own* adaptive responses to his environment. The antitheses, then, are on both the physiological and the psychological sides to be found between impulse as *hereditary,* and founded on inherited neural structure, and impulse as *individual* and reflective of innate *personal* disposition. The first factor represents the element of conservatism and racial habit, the second the element of individual variation and progress.

CHAPTER XVIII

THE NATURE OF EMOTION

Distinction Between Emotion and Instinct.—Our previous study has already brought us into contact with emotion, once in our analysis of feeling, and again in our examination of instinct. But it still remains for us to discover more exactly the peculiarities of this form of mental experience, and especially to point out its functional significance in the economy of conscious life. It will not be necessary to discuss its neural basis. The relevant facts have all been mentioned. The important part played in it by the autonomic system should, however, be emphasised and will become obvious as we proceed.

Although, as they appear in human beings, instinct and emotion are both psychophysical processes, the term "instinct" refers primarily to physiological phenomena, and the term "emotion" to psychological. This is brought out in James' statement that "an emotion is a tendency to feel, and an instinct is a tendency to act characteristically when in the presence of a certain object in the environment." As psychologists we are accordingly under obligation to describe the salient features of these hereditary feelings which accompany the instinctive activities. In the last chapter we found that impulse is present in all instincts, and we exhibited some of the modifications which the impulsive feelings undergo. We must now scrutinise certain other equally important features of the emotional psychosis.

When we feel ourselves in the grasp of any of the more powerful emotions, such as fear or anger or grief, we immediately refer the experience *in toto* to the object which is, as we say, its cause. We say we are afraid *of* the lightning, we are angry *with* our defamer, we are grief-stricken *at* the death of a beloved friend. In this way we come naturally enough to identify the emotion with our consciousness of its immediate provocative, and this fact has often served to becloud the real psychological constitution of these experiences. Thanks to the acumen of two contemporary psychologists, James and Lange, we can now describe more precisely than formerly certain of the psychical conditions indigenuous to such states of consciousness. These are closely dependent upon certain physiological processes.

Physiological Accompaniments of Emotion.—Let us take the case of a person who is extremely timid about thunderstorms. Such a person may be thrown into a paroxysm of fear by the sight of an ominuous cloud approaching. Moreover, after the storm has burst, every flash of lightning and every clap of thunder may serve as a fresh source for the waves of terror which surge over the shrinking soul. Now in such a case the usual description of the mental experience would connect the fear *immediately* with the *perception* of the cloud and with the several perceptions of lightning and thunder. The mere perception itself would be accredited with the instant arousal, without further intermediation, of the emotion of fear. Following the arousal of fear, and serving as expressions of it, would be enumerated the several motor reactions which the individual might manifest, *e. g.*, trembling, paling, palpitation of the heart, etc. Now, it need not be questioned that such perceptions as these suggested are perceptions of terrifying objects recognised forthwith as such. But the authors to whom we have referred have pointed out, with a wealth of illustrative detail, that the motor activities just mentioned occur in an essentially reflex way *immediately* upon the perception of the emotional stimulus. These muscular reactions necessarily initiate at once afferent neural currents, which set up sensory and affective disturbances that are promptly reported in consciousness. The Lange-James view insists, therefore, that all accurate introspective observation of such experiences reveals the *emotion* of fear as a conscious state in which *these motor reactions* are represented as essential and integral parts. We may apprehend an object in a cold-blooded and self-controlled way as terrifying and dangerous. This is a common experience among policemen, firemen, and soldiers of a certain temperament. But we never *feel afraid* unless we have already made certain of the motor reactions which characterise fear. If the heart remains undisturbed in its pulsations, if the distribution of the blood in the various parts of the body is not markedly changed, if the breathing is not affected, if we do not tremble, it matters not how clearly we may appreciate the danger of the situation, nor how dangerous the situation may be, the total complex feeling, the *emotion*, of fear is not ours. These movements, then, which common description accredits with the expression of the emotion, are not *merely* expressions, they are rather indispensable factors contributing to produce the psychical condition which we all recognise, when we experience it, as the genuine emotion.*

* Certain physiologists and alienists have called in question the correctness of this view. Experiments on animals, so operated upon as to prevent the cortex from receiving organic stimuli from the visceral region, are held to demonstrate that emotions are felt even under such conditions, which it is said should be impossible, if the James-Lange theory were strictly true. Disease sometimes produces in human beings similar conditions of cortical isolation from great groups of the organic senses and still emotion appears little impaired. Space does not permit a full discussion. In the author's opinion the critics have failed to take account of most important considerations, such as the possible effects of memory processes, not to mention other points equally significant. No evidence as yet advanced appeals to him as crucial in its discrediting of the essential points of the theory, for which a vast array of confirmatory evidence is at hand.

The psychological constitution of the emotion of fear is typical of all the strong emotions which lend themselves readily to introspective observation. In each one the organic reverberation which is produced by the emotional stimulus enters into consciousness to give it its characteristic emotional colouring and to mark it off from other modes of mental activity. In anger we ordinarily find the breathing disturbed, the circulation irregular, and many of the voluntary muscles, *e. g.*, those of the hands and face, tense and rigid. These muscular movements are inevitably reported by distinct modifications in the tone of consciousness. In grief an opposite type of muscular condition is met with, *i. e.*, depression of motor tonicity throughout most of the system, but with an equally inevitable reaction upon the conscious mood.

Emotions are, therefore, extremely complex processes, so far, at least, as regards the organic activities which condition them. In emotions we are not only conscious of the emotional object, as in ordinary perceptual and ideational acts, we are also overwhelmed by a mass of sensational and affective elements brought about by the intra-organic activities of our own musculature. The prominence of the affective factors to which we have referred in our account of feeling is in large part referable to the hyper-normal, or subnormal, activity set up in the muscles of the respiratory, circulatory, and digestive systems. It will be remembered that under most conditions we are entirely unconscious of these processes. Only under rather unusual circumstances, involving some vivid form of stimulation, do they intrude themselves. But such circumstances, we have already observed, are precisely those to which affective tone almost inevitably attaches, and we have forthwith an obvious reason for the conspicuously affective character of the emotions.

Reply to a Criticism.—It may be said that however true our account of the organic activities involved in emotional psychoses, it is, nevertheless, a false description of the facts to say that we are *conscious* in any *explicit* way of these functions of our bodily selves. Our consciousness, it is alleged, is absorbed in the *object* of the emotion; we are hypnotised by the impending calamity, transfixed in contemplation of our gaucherie, swept away by the sally of wit, etc. The bodily movements are things of which we have little or no distinct mental report. The emotion, consequently, however much entangled with motor activities it may prove to be, cannot be spoken of as consisting in a consciousness of these movements. The point at issue in this contention rests upon a misapprehension of the principle defended in this chapter. It is not maintained that the emotion of fear is made up of a consciousness of some terrifying object, say a serpent, plus the consciousness of a palpitating heart, plus the consciousness of shaking limbs. The assertion is, that our *consciousness* of the *serpent* is *modified* by all the sensory-motor activities going on in the body at the moment, just as is the case in less noticeable degree with every perception. It is further asserted that the motor activities which do occur at such times are characteristic and relatively fixed, and in consequence lead to *relatively fixed psychical* surroundings for any perceptual acts revealing terrifying objects. To state it in neural terms, we may say that the cerebral cortex is a kind of resonance board for the whole organism, and that emotional stimuli produce *definite* and fairly *constant* motor reactions, which are echoed by the cortex. Our attention may, then, be more or less absorbed in the object of any given emotion, but the total mental state is conditioned quite as truly by the sensory consequences of the hereditary motor disturbances, as it is by the special sensory activity reporting the object. These motor disturbances constitute in James' terms a characteristic "fringe" for the emotional stimulus.

Memory Traces in Emotion.—If emotions involve these organic sensory factors, we must have modifications in memory occasioned by them, and upon experiencing a new emotional stimulus there must be a disposition to call up these old organic reminiscences. It may be then that emotional objects occasionally elicit relatively little of *direct* motor reaction, while nevertheless evoking mental states characterised by these memory traces of previous organic excitement. Such a supposition would account reasonably for the composition of many of our milder emotions, the so-called higher emotions, in which it is often difficult to detect definite organic disturbances.

Classification of Emotions.—Many classifications of emotion have been proposed, but we shall only mention one, as the others do very little to aid in the appreciation of the inner nature of emotional conditions. Indeed, the one we cite has not as yet proved itself especially fertile. Emotions may be divided into primary, which do not involve any preceding emotional experiences upon which they depend; and secondary, or derived, which do thus implicate some such antecedent experience. Anger and fear illustrate the first group; certain forms of remorse and pity illustrate the second. We can hardly pity one in grief, unless we have ourselves suffered grief. Gratitude is generally of a similarly sophisticated type. The distinction underlying this classification is obviously genetic, and so far as it indicates real differences in the part played in our emotions by experience, it is helpful.

The so-called pseudo-emotions may be mentioned here. The name is used to designate such mental states as are induced by the creations of art, especially the dramatic and literary arts. If one becomes engrossed in a fine novel, one feels tremendously the misfortunes which overtake the hero and heroine, and still the emotions which one experiences differ distinctly from the first-hand emotions called forth by a like fate in one's own life. The grief which we feel for the novelist's characters may be sincere, but it is ordinarily much paler than a real grief of our own; and in many phlegmatic persons it would be difficult to discern any external manifestations of the excitement, such as you might detect when the emotion was stirred by real events. Speaking broadly these pseudo-emotions are merely weakened editions of the originals from which they obviously spring, but they have many peculiarities, such as bringing us pleasure where the original would have been unmitigatedly painful.

Significance of Emotion.—We must next inquire into the special significance of the emotional life, and discover, if possible, the reasons for its peculiarities. In emotion we are apparently confronted with a case in which now and again consciousness takes on an unusual intensity. Can we find in our analysis of its intrinsic characteristics, or in our observation of the circumstances under which it becomes manifest, any explanation of this phenomenon? We may at least make the attempt.

Illustrations from (1) Fear.—If we examine a series of emotional situations, such as we find in grief, anger, fear, embarrassment, and pity, we shall discover that in one particular they all agree. In each and every case conscious activity is thrown backward and inward upon itself instead of going forward in the form of well-adjusted processes of control. This condition may last only a moment, or it may run on indefinitely. In one form or another, however, it is the distinguishing mark of all emotional conditions. For example, I am sitting at my desk writing, oblivious of the storm without. Suddenly a blinding flash and a deafening noise, followed by the sound of falling walls, breaks in upon me. Unquestionably, I am thoroughly frightened. For a moment or two I am all but paralysed mentally. My attitude is one of cowering contemplation. In a vague, terror-stricken way I wonder what is coming next. I may have started to my feet, but that is almost a reflex act, and certainly evinces no special intelligence, for I am perhaps quite as well off, and quite as useful, seated as standing. In a moment the paroxysm has passed off and I start forth to see what damage has been done. So long, however, as the fear was in the ascendency, my mental activity was of the most futile, inefficient character. At great conflagrations, where persons become panic-stricken under the continued influence of terror, a similar thing is observed. Either they sit cowering in a half-dazed condition, or they rush madly and aimlessly about. Rational conduct has fled, and consciousness has become almost extinct, or else a mere riot of impulses.

(2) **Embarrassment.**—In profound embarrassment everyone who is capable of the emotion will recognise the applicability of our description. We find ourselves speechless, not simply because the mouth is dry and the tongue paralysed, but also because our thoughts have fled. We have been suddenly reduced to the mental condition of a vegetable, growing rooted to the spot where we stand, a vital mass destitute of informing intelligence.

(3) **Grief and Anger.**—The prostrating effect of deep grief is nowhere more flagrant and more distressing than in the total inability of the mind to get away from the source of its sorrow and take up the direction of necessary activities. For a person deeply afflicted, freedom of will and action is a sheer delusion. The mind refuses to operate, save in reiterated contemplation of its loss. In anger, on the other hand, it may be at first supposed that mental and motor activity are alike enhanced, rather than otherwise. But this impression proves erroneous upon a closer inspection of the facts. The immediate and instantaneous effect of anger is precisely like that of the other emotions we have just mentioned, *i. e.*, the intrusion of respiratory, circulatory, and digestive disturbances with the temporary checking of directive conscious processes. The checking is often only momentary, and is then frequently followed by a torrential motor discharge of a more or less efficient kind into the voluntary muscles, which readily serves to obscure the preceding and invariable

inhibition. In children one often sees this latent period during which the storm is getting up its destructive forces. Presently the apoplectic silence is broken by an outburst, which harks back in its violence to periods long antecedent to the dawn of civilisation.

Emotion a Phenomenon of Interrupted Conscious Action.—This break in the adaptive movements under the supervision of consciousness, which we should observe in all emotions if we took time to analyse all of them, is reflected in the organic reactions which we have already described. The stimulations to which consciousness is responding from moment to moment must drain off through motor channels of some kind. So long as they do not possess emotional vividness, they call forth either simple reflex responses, or habitual coördinations under conscious control. The moment the stimulus takes on an emotional hue, however, as we have just seen, the guidance of consciousness is more or less abridged; the motor channels of acquired coördinated voluntary movements are consequently somewhat obstructed, and the only alternative is an overflow of the nervous currents into the involuntary pathways and the instinctive hereditary pathways of the voluntary system. On the neural side, therefore, the profuse motor reaction in emotion represents the discharge of dammed-up impulses which cannot find egress through the sluice-ways of ordinary voluntary movements.

Meaning of the Interruption and Motor Overflow.—Taken in their entirety, what do these two great bodies of fact point to, regarding the *function* of emotion, *i. e.,* (1) the temporary suspension of voluntary control in the forward movement of consciousness, and (2) the overflow of motor impulses into channels leading partly to the involuntary muscles and partly through hereditary influences to the voluntary system? Stated differently: What makes a situation emotional and why does it lead to these results which we have designated?

If it be true that consciousness tends to appear where the reflex and hereditary responses of the organism are inadequate to cope with the demands of the environment, we may say with equal truth that emotions appear whenever there is *conflict among the motor impulses called forth by any special situation.* Both cases demand fresh adjustments of consciousness for the securing of efficient action. *The significance of emotion as a fact of consciousness would seem, therefore, to be resident in this monitory function, represented by its compelling announcement of needed adjustments, its report of unstable equilibrium.* At all events this is evidently the part it plays, be its teleology what it may, and obviously this conflict with an impediment in the course of carrying out coördinated activities is the universal occasion of its appearance.

Such a view as this finds its most immediate and striking confirmation in the depressive emotions like fear, grief, and embarrassment, but it is not less true of the more sinister emotions, such as anger and jealousy, and it seems to be obvious enough in certain moral crises, in which we speak of the "pangs of conscience." The period of abortive voluntary control is often brief, and frequently the resumption of coordinated action antedates very much the cessation of the organic emotional disturbances. One suffering the depths of grief may thus take up again the weary round of a blighted life, despite the gnawing pain at the heart and the constant presence of the face that has gone. When we turn to the more mirthful emotions, it may not appear so certain that the same principle maintains, yet careful observation will assure us that it does.

Our appreciation of wit and humour certainly involves this form of readjustment. The joke is *par excellence* the typical stimulus provocative of disorganising tendencies in our coordinations. We listen to the skillful *raconteur,* our minds following step by step the evolution of the epic, and then, presto! the unexpected occurs, our minds react to the shock with an appreciation of the anomalies of the situation. The motor discharge in laughter announces the relief of the energy pent up momentarily by the unforeseen *dénouement,* and the total experience constitutes our feeling of the funny, the odd, or the amusing.

On the whole, then, there seems no reason to question the essential validity of this general view of the function of emotion and the conditions which call it forth. We may, therefore, revert with advantage to certain points in our analysis of instinct which must be brought into connection with our theory of emotion. The utility of the motor attitudes of emotion will be there discussed, a topic bearing directly upon the subjects just considered.

CHAPTER XIX

GENERAL THEORY OF EMOTION

Further Relations of Emotion and Instinct.—We noticed in a previous chapter that our instinctive reactions are accompanied by consciousness, and we observed further that the consciousness is of the kind which is commonly called emotional. We did not, however, point out the striking fact that this emotional element varies very greatly in the several kinds of instinctive activities which we discussed. This variation characterises not only the qualitative features of the emotion, but especially and conspicuously the intensity of the mental disturbance. After the considerations of the last chapter, it is unnecessary to dwell upon the vivid and tumultuous nature of the conscious processes in anger, fear, grief, and the reactions of this type. We observed in the cases cited that much of the stinging intensity of the experience is derived from the afferent nervous impulses originating in muscular disturbances of the digestive, circulatory, and respiratory tracts. On the other hand, in such impulsive operations as imitation and play these intra-organic disturbances may be largely lacking. The mind is, under such conditions, monopolised with the achievement of the objective act, and is affected much less definitely by the sensory stimulations of the systems just mentioned. So far as these systems do contribute to modify the condition of consciousness, it is commonly in the direction of creating a feeling of general bodily well-being, emanating from the vigorous normal activities of the vital organs.

We must conclude, therefore, that even though we are obliged to admit a minimum measure of emotional tone in all instinctive or impulsive acts, which we refer forthwith to the bodily resonance aroused by all such acts, nevertheless, some instinctive activities are markedly emotional, whereas others are not. Those which are obviously of the emotional type present instances in which the motor reaction is largely confined, so far at least as concerns its immediate significance, to intra-organic disturbances. The defensive emotion of anger is the only one which regularly reveals any strong tendency to pass over into acts producing changes in the surrounding objects. Such impulses as those of play tend, on the contrary, to pass immediately over into acts affecting one's surroundings. In both the more and the less emotional forms of instinct the motor activities are supposedly determined by racial hereditary influences, but in the emotional form this determination is relatively more definite, and often more elaborate, as in fear; whereas, in the less emotional form it is little more than a disposition or tendency to certain kinds of reaction, which are, however, highly modifiable.

While we possess, then, inherited tendencies to acts which seem to affect primarily either our own organism or the environment, as the case may be, it is the former of these tendencies rather than the latter which is ordinarily called out by obstacles to our progress. Whenever such obstructions (perceptual or ideational) are encountered, the motor discharge is thrown back upon the vital processes of the organism itself, and straightway we have an emotion. It now remains to discover more fully, if possible, the meaning of this situation.

Genesis of Emotion.—We described in chapter XV the general theories touching the origin of instincts, but we may profitably consider again, in connection with our analysis of emotion and its variable connection with instincts, the question of the genesis of emotional consciousness.

Our study of the various cognitive processes, such as perception and memory, and our study of affective phenomena, have enabled us to ascribe in every case some specific function, or group of functions, which each process serves in the general economy of mental life. The essential problem now before us is to find the real function of emotion, and to account, if possible, for its specific forms. We have already noted its appearance under conditions of stress and tension requiring new conscious coördinations, in order to permit progress, and we have connected this fact with the service of emotion as a general monitor reporting friction and the need of additional intelligent supervision. Can we, however, locate the source of this friction and give it its intelligible setting in the history of organic evolution? Can we, moreover, discover any reason for the differences in the qualities which the emotion of fear manifests when compared with grief? If the monitory character of emotion contained an adequate explanation of its function, it does not appear why these two emotions mentioned should display any such radical differences. From this point of view, all that is required is some index in consciousness which shall, with a maximum of certainty, attract attention to the difficulties to be overcome.

The direction from which we may unquestionably look for assistance in answering these questions is that hinted at in the account of the evolution of instinct. The best exposition of this theory, and the one which we shall adopt in a general way, has been given by Dewey. His theory can hardly be called conclusively proven, but it is unquestionably the most plausible and luminous exposition of the Darwinian hypothesis, in connection with the Lange-James theory, which has been as yet attempted, and we shall certainly be wise in accepting it provisionally.

Put briefly, it is this: The peculiar feeling which marks each emotion off from other emotions is primarily due to the different reactions which various objects call forth. These reactions are in turn determined by circumstances, which may lie indefinitely far back in the early history of the race, but in each case they required for their effective manipulation special forms of coördination. The coördinations which served these ends were necessarily useful, and so tended to become fixed as organic heritages. Every emotional reaction represents, therefore, the survival of acts *originally useful,* either in the immediate physiological way, or in the indirect biological and social way. Wundt and others also recognise forms of reaction which tend to copy already established responses to stimuli, that arouse "analogous feelings." Thus we raise the nostrils in token of moral disgust, just as we do at a nauseous odour. In the present-day individual these originally valuable reactions are not commonly executed as they once were, for they are no longer unequivocally useful. But they appear now in the form of attitudes, or tendencies to action, which are, however, in part inhibited from expression. This inhibition is due to the fact that, owing to our personal experience and our present complex structure, the emotional stimulus tends to produce *two* or *more* different motor reactions, instead of producing simply the old, instinctive, hereditary one. The emotion itself is in essence our *consciousness* of the *conflict* between the several reactions which the stimulus tends to call forth. The conflict subsides only when the two or more groups of nascently aroused coördinations are in some way unified and brought into a larger and more inclusive coördination. Were there no such tendencies to specific forms of movement originally appropriate to special conditions, undoubtedly emotions would be either all alike, or else utterly irregular and disorderly. One or two illustrations may serve, in connection with our previous analysis, to make this general hypothesis clear.

Illustration of the Principle.—Suppose that in walking across a meadow we are suddenly beset by an irate bull. So far as the bull is an interesting and unfamiliar object the visual impression which we get of him undoubtedly tends to bring about such movements as may permit us to examine him more closely. Such tendencies involve movements of approach. In so far, on the other hand, as he is a roaring, devastating mass, indulging a high momentum in our direction, he equally stimulates motions of defence and retreat. Now, however it may be with the first group, this second group of tendencies is very largely instinctive in origin, and involves movements which unquestionably were originally of practical utility, whatever their present worth, *e. g.*, the breathing temporarily checked, as on all occasions immediately preparatory to severe effort; the increasing rapidity of heart-beat, with its consequent augmentation of the circulatory efficiency, etc.; all making for the maximum chance of successful escape from danger. If either of these groups of impulses were carried over into immediate action it seems improbable that the *emotion* of fear, as we know it, would appear at all. Certainly the expression of the motor tendencies indicative of curious interest would not produce fear, and if the impulses looking toward retreat were absolutely alone in the field, it is altogether likely that we should have conditions akin to those which characterise the free expression of the play impulses in children, *i. e.*, heightened sense of vitality, but no such emotion as fear. Evidently these two groups of impulses called forth by the ominously interesting bull cannot both be expressed simultaneously, and in point of fact they tend to inhibit one another. It is the organic outcome of this conflict of impulses, of which we become so keenly conscious as the "emotion." If the disposition usual in such cases finally conquers, we take to our heels, and at this point an instructive confirmation of our theory occasionally comes to light.

If we succeed in *really* putting our *whole* minds into the running, the emotion of fear is practically at an end. We may still have exhilarating, and even exhausting, mental excitement, but terror has fled with our own whole-hearted fleeing. In reality we often fail to throw ourselves thus completely into the act of flight, and instead of this, images of the pursuing fate keep rising in our minds. We hear the thunder of footsteps, and the air is rent with savage bellowing. Each one of these sounds may stir in us a fresh emotional paroxysm, and in just the same way as the original reaction was aroused. The impulse may be now strong to turn and see how near the brute has come, and over against this tendency is the impulse to run still faster. In this manner recurrent waves of emotion may overwhelm us, until haply we reach the point where free and unimpeded coordinations may once more fare forth. This is most apt to occur on the other side of the bull's fence. But in any case the emotion evaporates when the mutual antagonism and inhibition of impulses cease, and not until then.

A Difficulty.—It may occur to someone to inquire what becomes, on the basis of this theory, of the emotional outbursts of fear on the part of little children, too young to have *knowledge* of the objects serving as stimuli, and therefore, too young to have any of the acquired tendencies to reaction of which we have spoken, and to which we have assigned so important a part. We have, for example, previously mentioned the fear which children sometimes manifest of fur. The reply to this query is that such seizures are not, properly speaking, emotional at all in the sense in which the adult experiences emotion. True emotion distinctly implicates an element of knowledge. We are afraid of this, that, or the other thing of which we *know* something which inspires our dread. Such reactions, therefore, on the part of children must be altogether on a par, as conscious processes, with the first consciousness of one's organic sensations. They may be disagreeable, and probably are, but they no more deserve the name emotion, before there is a knowledge (however rudimentary) of the significance of the stimulus, than do the immediate feelings of stomach-ache, of fatigue, or of general vitality.

The Case of Satisfaction and Joy.—We may take, as an antithetical illustration to put alongside our description of fear, the emotion of satisfaction, where it might seem that we have necessarily an essential absence of conflict and inhibition. But if we examine a specific instance of emotional elation, such as that which arises from victory in an athletic contest, we instantly meet evidence confirmatory of our view. Up to the moment of final success there has, we may suppose, been an oscillation between anxiety and exultation, as the tide of victory has ebbed and flowed. On the whole, however, if the contest has been close, anxiety and tension have probably dominated in consciousness. Now that the issue is closed, and the die is cast, a tide of riotous joy surges over us. We shout, laugh, and jump, wave hats, canes, umbrellas, whatever comes to hand; our next neighbour is the recipient of jovial thumps and punches, and our whole nature expands triumphantly in unconstrained complacency.

All these performances we think of as *expressions* of the emotion, and the analysis of the previous chapter implied that our consciousness of these movements constitutes the essential differentia of the emotional psychosis from other states of mind. The point we make here is one already mentioned in the account of impulse, *i. e.*, that we should not become so vividly aware of the movements were there not a tendency to *inhibit* them, occasioned by tendencies to make *other* movements. All consciousness, to be sure, seems to be toned more or less by the sensory reactions which arise from the constant overflow of neural excitement into the muscles, and in so far every psychosis has an element of emotion in it. But it is in connection with the conflicts sometimes encountered in the expression of our *racially hereditary* impulses that we get the full clear case, to which the term "gross emotion" is occasionally applied. In the instance of our illustration the inhibitive tendencies mentioned are primarily those expressive of our anxiety, and careful introspection will unquestionably show that the real feeling of joy and satisfaction is precisely contemporaneous with our mental portrayal of the strife and furor of the contest. When we cease to *live over again* in memory the crucial moments of the game, the emotion of joy has given way to some other more negative and quiescent state of bodily lassitude and content. It must, of course, be recognised that much which we commonly think of as mental satisfaction is really an altogether unemotional condition of placid vegetation. We stretch ourselves out after a good meal, and are at peace with the world. We are satisfied. But this condition must not be confused with the thrill and tension of real emotion, however undiscriminating our descriptive language may be in calling both experiences states of satisfaction.

A precisely similar situation will be found in every case of joyous emotion, whatever its cause. The lover who has at last carried love's citadel; the business man who has cornered his market; the scientist who has proved his theory—one and all get the thrill and poignancy of joy from the stress and eagerness of conflicting impulses in which the whole nature is enlisted. On the one hand are tendencies expressive of doubt, hesitancy, conservative retreat; on the other the expressions of forceful advance, of success and victory. The two sets of motor reactions are in unstable equilibrium, mutually inhibiting one another. The consciousness of our organic activities involved in this condition gives the mental background for our recognition of success, and the total psychical result is the emotion of joy. Once the victory is clearly recognised as won, and the game felt to be wholly over, our joy promptly begins to pale and fade. Moreover, let it not be supposed that intense joy is wholly unalloyed pleasure. Quite the contrary; such joy has its pain:

> "Our sincerest laughter
> With some pain is fraught."

To be sure, the affective tone of joy is dominantly pleasurable, and the reasons for this condition are not far to seek, as we shall presently see. But the emotion is a state of tension, and this fact is all too likely to be submerged from notice in our disposition to emphasise the *objective basis* of our joy, rather than the *mental experience* in which it is apprehended.

Possible Utility of Emotional Attitudes.—Why should these special expressions, however, characterise joy rather than others—say those which characterise grief? What utility have these reactions now, or could they ever have possessed, by virtue of which they appear in us as hereditary attitudes? In our discussion of instinct we commented upon the speculative nature of such explanations as we are about to suggest. In the light of present knowledge they seem, however, to offer the most plausible theory available.

The typical expression of joy is laughter, but laughter, let it be remembered, is also expressive of many other things, *e. g.*, surprise, derision, contempt, and even the more paroxysmal forms of grief—a circumstance which appears anomalous in the light of any theory other than the one herewith set forth. In all these cases the laugh is the motor activity which inevitably accompanies the explosive release from sustained tension, with its suspended breathing. In our account of the attentive processes in consciousness we remarked the holding of the breath as one among other adaptive motor arrangements, all of which involve muscular tension. In joy, in the appreciation of humour, in surprise after expectation, we meet precisely this suspension of breathing suddenly cut short. The innervation of the vocal, facial, and breathing muscles which this involves is the laugh. Stress has often been laid upon the rhythmic nature of laughter, and undoubtedly this is one of its essential features. But this does not distinguish it from other effective coördinations which are also rhythmic, and of which we shall have more to say in another chapter. Joy is, then, an emotion which, taken in its entirety, involves a measure of *antecedent* *tension,* to which the motor reaction involved in laughter and its accompanying gestures constitutes a necessary relief. The stimulus to these tensions is suddenly transformed, we behold it in a new light; the tension may, therefore, be released, and our consciousness of the entire process by which the release is progressively procured, as we apprehend the stimulus in a new way, *is* the emotion. The utility of the attitude of joy should accordingly be sufficiently obvious.

If space permitted, and had we not already touched upon essentially the same matter in discussing instinct, we might in a similar manner illustrate the original utilities of the attitudes peculiar to anger, grief, and the other rudimentary emotions. Thus, Darwin has suggested that the rolling up of the upper lip in anger is a vestige of habits which belong to the days when men fought with their teeth. The clenching of the fists has an unmistakable implication. The sigh in grief and the sobbing, which also belong to this emotion, are probably explicable along lines resembling those we have described in connection with joy. The sigh with its strong movement of inhalation perhaps serves to restore the deficient oxygenation of the blood. Certainly radical measures are often needed, for the depressor effect upon the tonus of the muscles is in many cases of grief so severe as to menace life. It would undoubtedly be interesting to canvass the expressions of such familiar emotions as reverence, hope, remorse, gratitude, shame, bashfulness, disgust, etc., but we must forego this. The reader must not forget, however, that the utility of these emotional attitudes is generally most evident in connection with their function in primitive conditions of life. This is certainly true of the reactions which have a definitely biological and social value in distinction from a merely physiological value. The more violent expressions of anger have practically no justification under civilised conditions of life, and other similar instances will readily suggest themselves.

The various acts which we call expressions of emotion are simply acts which are, or probably once were, useful under the circumstances calling forth the activity. It is, therefore, a genetic fallacy to speak as though the emotion first existed, and then sought an appropriate expression. The *expressiveness* of such acts is primarily a thing which exists only for some observer. The acts are, or at all events originally were, direct or indirect means toward the realisation of some end which the individual has in view. The movements of my hand, as I write, are not to *me* expressions of my thought. They are simply means to the end. No more are the emotional reactions primarily expressive to the person making them.

The Tender Emotions.—Before leaving the general subject of emotion, mention must be made of the tender emotions. Under this caption English psychologists group a number of our more delicate and spiritual emotional experiences. Here belong sorrow, pity, gratitude, reverence, benevolence, together with certain forms of love and sympathy. These emotions are for the most part "derived" and are very complex. They are generally well marked with either feelings of happiness or sadness, and they stand in most intimate relations with the sentiments of which we shall speak in a moment. They afford no exception to the principles which we have formulated. But their composition is often extremely difficult to analyse and they are frequently experienced in weak and attenuated forms which allow their organic motor accompaniments, whether excitor or depressor, to escape detection. They are sometimes called "higher or finer emotions" and are then alleged to offer exceptions to the account given by the Lange-James theory of the motor aspects of emotion. The reason for this assertion has just been indicated.

Mood and Temperament.—While emotions are called forth by specific objects, we are all familiar with the fact that for considerable periods of time we often find ourselves especially susceptible to certain forms of emotion. After receiving a piece of good news we may find every event for hours afterward tending to take on a bright and humourous colouring. On the other hand, it is an equally common experience to find that a fit of indigestion will cast a saffron hue over the most welcome fortune. This predisposition to special forms of emotion we call mood. It seems to rest upon definite organic conditions, which sometimes appear to be originated purely by intra-organic physiological disturbances, but which sometimes are evidently due to the residual effects of past emotions. In the latter case they are practically recurrent, or continuous, emotions. In either case they afford nothing essentially novel for our inspection. Under certain conditions of intense and relatively permanent emotion we speak of the condition as one of passion. Passion, however, is a term which is used very loosely in several other connections.

When we compare individuals with one another, one of the striking differences which we observe concerns their inherited susceptibilities and predispositions to certain forms of emotional response. This characteristic is one of the most important elements in the constitution of what we call temperament. Whereas mood indicates a relatively transitory disposition toward a certain emotional tone, temperament refers to a permanent tendency, contributing to the very warp and woof of character. In the conception of temperament intellectual and volitional attributes are also included, but the emotional factor is, perhaps, the most significant. The classical division of temperaments into sanguine, choleric, melancholic, and phlegmatic may be recalled. The sanguine and choleric types are alert and easily stirred, the latter displaying a more intense, the former a feebler, interest. The melancholic and phlegmatic types are slow in response, the former evincing a strong and vivid interest when once aroused, the latter manifesting a persistent but weak interest. While these characterisations serve to suggest certain familiar differences in emotional organisation, they are but rough-and-ready devices. Individuals vary in dozens of significant ways not taken into account by these classifications, *e. g.*, in memory, in attention, in imagination, etc., and one of the results for which we look to individual psychology is a more penetrating and exhaustive analysis of the elements constituting temperament.

Sentiment.—Emotions are not dependent upon bodily conditions alone for a soil favourable to their development. Indigestion may, indeed, render us prone to irrational irritation and depression, and blooming health may constitute an auspicious prologue to emotions of joy. But another circumstance must be added, if we are to include all the conditioning factors. This additional consideration is found in the trains of ideas which possess our consciousness at any moment, and particularly in those general habits of thought and reflection which characterise our more distinctly intellectual life. If our customary habit of thought is of an altruistic and optimistic turn, there can be no question but that we shall more readily respond to emotional stimulations of the sympathetic type, than if our minds are sicklied o'er with a paler and less human cast. *These relatively permanent dispositions are what we designate our sentiments.* Love, friendship, enmity, etc., are the names by which we know such characteristics. It will be obvious at once that the relation between sentiment and emotion is in a sense reciprocal. Our sentiments predispose us to certain kinds of emotion,—or put more truly, *are* the predispositions to such emotions,—whereas the cultivation of any emotion tends as a rule still further to fix the disposition which it reflects.

Like feelings and emotions, sentiments may be classified in many ways, but the results are quite arbitrary and not profitable for consideration here. The division into concrete and abstract may be mentioned. Abstract sentiments would be illustrated by love of truth, of science, or art, or letters. Concrete sentiments are such as love or reverence for parents.

Relation of Emotion to Other Conscious Processes.—If we undertake to connect our analysis of emotion with the account we have already given of other mental processes, it will at once be evident that we have been dealing with a very complex psychical condition. Clearly there must always be a cognitive element in emotion. We apprehend some object, some circumstance, which is what we call the cause of the emotion. This apprehension inevitably involves *attention* and the assimilative, or associative, activities which we remarked as invariably accompanying cognition. Furthermore, we have repeatedly emphasised the strong affective tone which emotions display, together with their marked motor attitudes, and many of the emotions to which we have referred had already been mentioned as "feelings." It seems desirable to dwell a moment upon the nature of this identification of certain emotions and feelings. It must be definitely understood at the outset that *all* emotions are feelings in the meaning assigned by us to the term feeling. The question we are now briefly to consider is simply that of the precise implication of certain of these emotions to which we had previously accorded a classification as feelings.

Feeling and Emotion.—When we speak of sympathy we sometimes mean to indicate a definite feeling which has many of the characteristics of emotion, and sometimes we refer simply to a sentiment, to a general attitude of mind. The same ambiguity attaches to our use of the opposite condition, *i. e.*, antipathy, and to many other so-called feelings, *e. g.*, pride, humility, love, and hate. The moral feeling of obligation, or the feeling of conscience, affords a further instance of an emotional psychosis, often extremely intense and characterised by distinct motor attitudes. It is at times highly complex in composition, having in it elements of fear, remorse, awe, and the like. The feeling of dependence, which plays so essential a part in religious phenomena, the feelings of reverence and of faith, all have at times an emotional colouring which cannot be questioned.

The æsthetic consciousness offers repeated instances of feelings which are tinged with emotion, although it must be frankly confessed that much which masquerades as æsthetic appreciation is, even when sincere, far too cold-blooded, far too strictly intellectual, to lay any claim to an emotional character. The orchestral rendition of a Beethoven symphony may fill us with the most genuine and delightful emotion, it may interest us merely as a superlative achievement of technique or it may, frankly, bore us. Evidently its claim to the production of a positive and unmistakable emotion will depend, in part at least, on such circumstances as our mood and our musical development. But it must not be supposed that intellectual activities are, as such, necessarily devoid of all emotional context. We already know that they may possess marked affective tone. The experience of wonder is often a genuinely emotional one, and it is distinctively an emotion belonging to cognitive processes. Belief, too, is often a distinctly emotional experience. Yet belief is essentially a judging process with a complicated development and an intimate dependence upon volition.

The fact of the matter is that such forms of mental life as these which we have just been mentioning are astoundingly elaborate products of our developing consciousness, and although we find evidences here and there in them of native emotional reactions, they are, in our adult life, anyhow, inextricably intertwined with the results of previous personal experience. This makes it impossible to regard them merely as emotions of the purely hereditary type to which the earlier analysis in this chapter has been mainly devoted. But despite this qualification, we see at once whence it is that they get their astonishing impulsive power over us. However small the seed, there can be no doubt that each of these feelings, for which our language has so complex a system of titles, contains within itself the hereditary racial tendencies which constitute and explain the imperiousness of emotion. The truth of this assertion is confirmed by the essentially social character of the most important of these feelings—a point already touched upon in chapter XIV. This social nature of ethical feeling hangs together with the necessarily social character of righteousness. The religious feelings are not less social, so far as they may be conveniently distinguished from the moral feelings. But they find their application in a social order which transcends in part at least the imperfections of life as we know it here. The æsthetic feelings might appear to be purely personal. But a further study discloses the fact that the social element is fundamental here, too. This is, of course, exactly what we should expect of any conscious process which betrays an emotional cast, for the emotions reflect racial habits, and these must inevitably have a social basis.

CHAPTER XX

ELEMENTARY FEATURES OF VOLITION

All of our study up to this point has been devoted to the several distinguishable features of consciousness by means of which mental operations are carried on. We have discussed the several phases of the cognitive activities, such as memory, imagination, perception, conception, judgment, and reasoning. We have described the salient peculiarities of the affective processes. We have analysed the racial hereditary traces in consciousness as shown by emotion, and we have from time to time exhibited the different forms of motor coordinations with which the organism appears to be endowed, and through which it executes its adjusting movements. It remains for us in the following chapters to bring these various descriptions and analyses into perspective with one another by examining in its entirety, and with much more of detail than was furnished in chapter III, the development and character of voluntary control.

Method of Study.—Hitherto we have made it a general practice to begin our study of a given mental process by analysing its more conspicuous and characteristic features, and then, with this as a starting point, we have turned back to trace, whenever we could, the genesis and function of the process in the individual or the race. We have always laid great stress on this genetic side of the case, because it is evidently impossible to evaluate and interpret a biological phenomenon intelligently unless one knows its antecedents, and mental facts furnish no exception to this rule. But, on the other hand, mental facts are so complex and elusive that an effort to trace the unfolding of consciousness can hardly be successful save when one has already some inkling of what to look for. In the investigation of volition we can proceed with a much larger measure of freedom than heretofore, because we have already dealt with the more important elements concerned, *e. g.*, attention, sensation, perception, ideas, and movements. We shall, therefore, after a brief analysis of these elements pass on to considerations of a primarily genetic kind. Subsequently we shall return to consider the more complex relations of voluntary acts.

General Analysis of Volition.—When we direct our attention to the immediately discernible features of voluntary acts in adult life, we note that such acts always involve foresight of some end, that this end is desired or at least consented to, and that certain muscular movements then occur which are meant to attain the end.* We observe, further, that on some occasions the mere presence of a percept or an idea carries with it instantly and without deliberation the execution of movement, whereas on other occasions arrival at the stage of mental consent requires long trains of reflective thought, and movements expressive of the decision may be postponed indefinitely. Sometimes the decision seems to be a relatively passive affair which makes itself on the basis of the facts considered. Sometimes, on the other hand, the whole self seems to be projected into the choice, and the consciousness of this mandate of the will is designated by James and others as the "fiat." Moreover, we observe that ordinarily the attainment of a decision finds the muscles already capable

* Inasmuch as certain decisions seem primarily to concern our trains of thought rather than our muscular activities, as when we resolve to continue a course of reflection, our formulation may appear to emphasise unduly the motor features of volition. But it must be remembered that voluntarily carrying on a process of thinking requires the securing of definite motor attitudes, and furthermore, that all such thinking has as its purpose some future action, however long deferred we may expect this action to be.

of carrying out the necessary coördinations, but occasionally the will can command no adequate motor agents. We may readily illustrate certain of these cases.

As I sit at my desk I feel a draft. Without a moment's hesitation I rise and close the window. Here is a *sensory* process, followed immediately by an appropriate movement of voluntary muscles. Again as I write, a word comes into my mind about the spelling of which I am uncertain. Instantly I turn it up in the dictionary. Here is an *idea* followed promptly by a movement of the volitional kind. As I proceed with my writing I come to a point where I must decide whether or not to incorporate a certain subject in my text. The merits of the question require long and careful consideration. Finally I decide to drop the matter from my book, and forthwith my writing goes on upon another topic. In all the cases thus far cited I have been in command of the motor coördinations needed to realise my purposes. But if I suddenly desist from writing and decide to step to the piano in the next room and indulge in a sonata, my willing becomes a mere burlesque, for I cannot play.

We may safely start, then, from the assumption that every voluntary act involves the presence in the mind of sensory or ideational material in some way anticipatory of the act. With this doctrine as a point of departure we must examine more precisely our volitional consciousness and its relation to our movements. So far as the "fiat" represents in the author's opinion a genuine feature of volitional processes, it will be discussed in a later chapter in connection with the consciousness of effort. It will evidently be judicious to select for our present study acts which differ as widely as possible in their antecedents, in the character of the results achieved, and as regards the muscles employed in their accomplishment. Let us first, then, consider such a variety of voluntary acts in which different muscles are concerned. Although cast in personal form, the descriptions offered are based upon experiments made by a number of observers. The reader must compare his own experiences with them.

The Sensory and Ideational Elements of Control Over Voluntary Acts.—When I wish to sing or whistle a melody, I observe that the appropriate muscular movements follow the presence in my consciousness of auditory and kinæsthetic images. I seem first to hear the melody mentally, and to feel the sensations which come from my throat and lips when I do actually sing or whistle. After I have once started, the sound of the notes may serve to awaken the movements for their proper successors. In writing, on the other hand, I observe, especially in the case of words which are difficult to spell, that my movements are more or less controlled by visual imagery. I get a glimpse at a visual image of the word to be used. In this case, however, I am also often aware of auditory images of the sounds of the sequent letters as they would be heard were the word being spelled aloud. There is, moreover, a rather constant escort of kinæsthetic images arising from the influence of former sensations of the hand movements employed in writing the word. I may use as cues for the ensuing movement the kinæsthetic sensations originating in the muscular contractions of the hand, from the attitudes it assumes. Even the sound of the scratching of the pen may be utilised as a means of control.

Whenever the coördinations are very familiar and habitual, as commonly occurs in writing, the mere general thought of what one is about to write will serve to instigate the movement. In such cases our attention is so fixed upon the meaning of the writing, that we are generally entirely oblivious of the special form of control involved. The mere pronouncing of a word or the use of any understood signal may elicit the proper motor attitude, which can then at pleasure be converted into movement. Moreover, in such habitual cases, long trains of coördinations may be set in movement by a single cue at the beginning. This sort of thing is illustrated by our ability to repeat memorised material of any kind whether expressed through hand or lips. But, if examined experimentally, in all these cases short of pure automatisms, the guiding support of the accompanying sense processes will be found indispensable. Through touch or vision or hearing we must be occasionally informed of our progress.

In throwing at a mark my attention is almost wholly absorbed in looking at the spot for which I am aiming. The control of the throwing movement in this case is largely from visual sensory currents, dimly reinforced, however, by kinæsthetic impressions from various parts of the body. In jumping from a standing position there is first a visual perception of the distance or height to be cleared, followed almost instantly by a setting of the various muscles of the body involved in the act, with a consequent mass of kinæsthetic sensory impressions aroused by these muscular contractions. When these sensations have reached what is judged to be an adequate quality and intensity, the mind says "go," and the jumping occurs.

These illustrations suggest that sensational or ideational processes may be used indifferently as the immediate precursors of coördinated movements, and they suggest, furthermore, that *any kind of sensory or ideational material* may be used in this way. Our cases have disclosed auditory, visual, and kinæsthetic qualities, but a further search would have revealed still other forms.

If these cases seem too trivial to be fairly illustrative, we may turn to a case involving some serious practical consequences, *e. g.,* the consideration of a large investment. It will, however, be seen at once that such a case promptly reduces to the form of reasoning. We may, therefore, without more ado refer back to the evidence which we presented in our discussion of that activity, to show that, so far as we are dealing with clearly conscious process, meaning-bearing imagery of one kind or another is a constant feature of it.

Linguistic imagery is likely to be conspicuous, although we have seen that certain persons are so absorbed in the meaning of their thoughts as often to be oblivious to the character of the constituent material. We shall find ourselves on such occasions as that of our illustration passing in mental review ideas which represent the pros and cons of the proposed investment. Little by little one of these groups of ideas begins to displace the other, and to become more firmly organised in our consciousness, until at last the opposite group is altogether vanquished and devitalised. The expression of our decision may take verbal form, or it may result in our writing a check, or making some other equally significant motor response.

Types of Connection Between the Sensory-Ideational Elements and Movements.—Now if we call to mind each of our illustrations we shall notice that in certain cases the idea which apparently controlled the voluntary act was an idea of the movement itself. This is partly true in the case of singing, more largely true in the case of jumping, where peripherally aroused impressions predominate over those centrally aroused. That is to say, in certain instances *kinaesthetic sensations and images* furnish us the material by means of which we practically anticipate, and so control, the movement we wish to make. In other instances, however, the sensations and ideas have to do primarily with the *results* of the movements, or with something connected with these results in a secondary fashion. The auditory images used in the control of singing, whistling, and sometimes writing are cases in point. In controlling vocal movements in this way we are employing images which are copies, in a measure, of sensory impressions made upon the ear by the vocalisations. But when the hand movements of writing are thus controlled, *i. e.*, by auditory cues, we clearly have a roundabout connection between vocal spelling movements, with their auditory consequences, and hand spelling motions. In the case of our investment decision the ideas may have had to do entirely with the conditions of the markets, the vitality of our own bank account, etc., and the act which expressed the decision, *e. g.*, signing our name to a check, may never once have come to mind until the deed was about to be executed. We must recognise from these observations that the ideas and sensations by means of which we supervise our movements may be of the most various character, and their relations to the movements may be either very close, as in the case where they are kinæsthetic, or indefinitely remote. James employs a useful pair of terms in calling those ideas of movement which originate in the part of the body moved, "resident," designating all other ideas which arise from the consequences of the movement, "remote." It must be added, however, that in practice the severance of the two from one another is in most persons by no means so complete as his description implies. After we have commented upon another important characteristic of these volitional acts we must attempt to discover just how it comes about that the various forms of sensation and imagery which we have noted attain their connection with the relevant movements.

Attention and Volition.—More fundamental, perhaps, in volitional processes than the controlling imagery is the fact of attention. No idea can dominate our movements which does not catch and hold our attention. Indeed, volition as a strictly mental affair is neither more nor less than a matter of attention. When we can keep our attention firmly fixed upon a line of conduct, to the exclusion of all competitors, our decision is already made. In all difficult decisions the stress of the situation exists primarily in the tension between the ideas representing the alternatives. First one and then another of the possibilities forces itself upon us, and our attention will not rest for more than a moment or two upon any single one.

The *reaction experiment* allows us to study this play of attention under conditions of control. We are instructed to make a given movement, say of the hand, when a definite signal is perceived, perhaps a sound or a light. The time is measured between the signal and our response. We find that the time of the reaction varies greatly in dependence upon the direction which we give our attention. In general it is shortest when we attend to that part of the total activity which is *least habitual.* We may find our attention naturally tending to fall upon the movement to be made. In this case if we try to attend to the sound or light and make a "sensory" reaction, we shall react more irregularly and often more slowly. Most people are disposed in such cases to attend to the movement and this "motor" form of reaction is generally in consequence faster. As habituation proceeds it will become a matter of indifference to which part of the act we attend. The whole thing will have become highly automatic. It must not be overlooked that listening or looking involves motor processes, involves attitudes, just as truly as moving the hand. The distinction between "sensory" and "motor" reactions is really a distinction between two kinds of motor reactions, a less habitual and a more habitual, or possibly between two equally habitual.

The chapter upon attention brought to our notice a number of reasons for believing this process to be a universal feature of consciousness, and we can feel no surprise, therefore, to find it playing a dominant rôle in volition where consciousness displays its most significant characteristics. It is by means of our ideas that we anticipate the future and project for ourselves the lines of our conduct, but it is by means of attention that we actually succeed in making some one of the anticipatory ideas real in the form of action. Attention must have something to work upon, and this something is supplied in the form of sensational and ideational presentations. Attention is the function in which mental possibility becomes motor actuality. With this fact in mind, our next business must be the tracing of the development by means of which the various kinds of ideas which we find ourselves using to control our movements come to have this peculiar power. This undertaking involves our turning back to the conditions in infancy and early childhood, during which most of our important coördinations are established. The primary steps in volitional development are devoted to gaining control over bodily movements.

Transition From Random to Controlled Movements.—We have already had occasion in earlier chapters to inventory the capital of motor coördinations with which the new-born babe is endowed, and we have found it confined to a few simple reflex movements, for the most part poorly executed, to a few possibly "spontaneous movements," and to a store of automatic activities concerned with respiration, circulation, and nutrition. Voluntary action in any proper sense is wholly wanting, and this finds its immediate explanation in two considerations: (1) the psychological fact that voluntary action implies action toward some recognised end which the absence of experience necessarily precludes; and (2) the physiological fact that the cortical centres are still too imperfectly developed to afford interconnections between the sense organs and the voluntary muscles. The latter consideration is, of course, fatal to any immediate development of voluntary control, but even were the nervous system functionally mature at birth, the first difficulty would prevent the rapid establishing of such control. In our description of impulsive activities in chapter III we noticed that little by little the merely random movements of infancy become coördinated with reference to certain sorts of stimuli, until by the end of the third or fourth week, with most children, the eye movements can be controlled, and by the end of the twenty-fourth month all the more important rudimentary muscular movements can be executed. Now, what are the intermediate steps between this period of merely reflex, or random, impulsive activity with which the child begins life, and the period of voluntary motor control?

Elementary Principles of Transition.—We may lay down two general propositions to start with, which must be continually borne in mind in order to avoid misapprehension. These principles, which are sustained by all observation, are: (1) that all voluntary control is built upon a foundation of movements which are already going on in an uncontrolled impulsive way; and (2) that the development of control, although from the beginning it extends in a measure, perhaps, to all the voluntary muscles, proceeds more rapidly, now in one group and now in another. Broadly speaking, the larger muscles are first brought under accurate control, while later on the more delicate movements of the small muscles are acquired; a fact which should be taken into account in the early occupations of children. This law of periodic or rhythmic growth characterises all mental and bodily development. A child may have fairly good control of its eye movements, while the arm movements are still vague and inaccurate; and it may have acquired considerable dexterity with its hands, while still unable to command its feet with much success. Volition must not, then, be thought of as a process in which consciousness somehow brings into life movements which previously did not exist. The problem of the evolution of control is primarily the problem connected with the coördinating, in reference to certain ends, of movements already occurring in an uncoördinated way. *We are under no obligation to explain the existence of the movements.* They are already in evidence. Our problem is simply concerned with the *method of their systematisation, and their organisation,* in *connection with consciousness.*

Law of Excess Discharge.—Although we have in chapter III already noticed many of the significant facts involved in the process, we may profitably examine again a case illustrative of one typical form in which control over these unordered movements is secured. Let us suppose that a bright and noisy rattle is presented to the notice of a child who has learned to focus his eyes, but who is as yet unable to reach intelligently for objects. How does the child learn to grasp such an object, which he sees and hears? The rattle stimulates at once both eye and ear. The child's first reaction is, perhaps, one of astonished inspection, as he gazes at this unfamiliar thing. The noise continues and the bright colour catches the attention. The sensory currents from the two sense organs find no adequate drainage channels in the motor attitude involved in watching, and they begin to overflow into other channels. The pathways leading to the production of random impulsive movements are pervious and the overflow from the sensory disturbances naturally tends, therefore, to pass off in these directions. Consequently we presently see that the child is moving hands and arms and head more or less violently, and often the muscles of the trunk and legs are also much affected.

First Accidental Success.—At first these movements are inevitably spasmodic, vague, and uncoördinated. They simply suggest, as we observe them, some sort of explosion in the motor centres. But the continued presence of the rattle for a few moments is very likely to result in some movement of the arms adequate for grasping it.

The first step, therefore, in securing voluntary control of the hand and arm under such circumstances is based upon the tendency of the sensory stimulations to produce diffused motor discharges throughout many muscles of the body. Certain of these motor activities result in changing the stimulus in some way. The next problem is, therefore, concerned with the consequences of this fact, which in the case of our illustration consists in the successful grasping of the rattle.

Pleasurable Tone of Accidental Success.—When the rattle is actually grasped we have a new stimulus immediately introduced. In place of the rattle seen-and-heard, we have now the rattle felt-and-heard-and-seen-moving-with-the-hand. These distinctions, of course, cannot exist for the baby with any such definiteness as they do for us who are looking on. But they exist as differences *actually sensed,* however inadequately they might be described, supposing the child were able to express himself. The mere change of the stimulus visually attended to must, then, under the supposed conditions, serve momentarily at least to *intensify the child's attention* to the total situation. Furthermore, the grasping of the object, involving as it does a definite motor coördination of an efficient kind, is *per se* agreeable, *i. e.,* it is a normal activity of functions (in this instance instinctive) adequate to the demands laid upon them. The result of success in the reaching and grasping, with its agreeably heightened conscious tone, will accordingly accentuate the disposition to fix in the form of habit the total series of reactions which have led up to this particular outcome.

Progress After First Success.—From this point on progress is generally slow and tentative, as it is in the learning processes of animals, differing markedly in this respect from certain features of the process by which adults learn new coordinations. When the coördination is actually well matured, two striking characteristics distinguish it from the predecessors out of which it has grown. It is *accurate,* not hesitant nor vague, and it involves *only the muscles actually necessary* for its performance, instead of many others in various parts of the body. How have these useless movements been eliminated? We cannot reply to this question with as much definiteness and detail as is desirable, but the general nature of the process seems to be somewhat as follows.

Elimination of Useless Movements.—The baby's consciousness is all the time vividly enlisted in the movements which he is making, but the rattle furnishes the constant focus for these, and for the baby's attention. Of all the movements which are made, those are most likely to be noticed which are most intimately connected with the immediate field of attention. Needless to say, these are the movements of the child's own hands and arms, which he must see whenever they chance to approach the rattle, and of which he must be vaguely aware as often as they move. So far, then, as the rattle is the centre of the baby's attention, *those sensations will receive most emphasis in consciousness which are most immediately connected with it, which coalesce most readily with it into a single experience, changing when it changes, remaining unchanged when it is unchanged.*

Once again, let it not be supposed that we are for a moment offering such an analysis as the above as an account of anything present reflectively to the child. His naïveté may be as great as possible. We are simply describing the kinds of sensations which must apparently get most conspicuous representation. The situation seems to hinge, for the explanation of its development into controlled movement, with lapse of useless movements, upon the *pleasurable fixation of attention* on the rattle and the consequent emphasis of all sensations caused by movements affecting this centre of attention. Such movements as regularly affect the rattle are thereby necessarily emphasised, so long as the rattle is the object of attention, and the predisposition for the sensory impulses to drain out through them is heightened. The others fall away largely because the neural energy is adequately provided for in these new-formed pathways. But they do not fall away at once, and the effective coördination is not set up at once. The process is slow, and gives every indication of being a real growth.

The Case of Ideational Control.—Our explanation thus far has been cast in terms of the law of habit, operating under the intensifying effects of agreeable attention upon motor discharges of an impulsive and excess-discharge type. It suggests an explanation of how it might come about that when an interesting object is placed before a child he might be able to reach it. But what explanation does it afford of the ability voluntarily to control the hand and arm movements of this kind when a stimulating object is wanting? How does it account for the origin of such ideational control as was evidenced in our analysis of adult volition at the beginning of the chapter?

The facts upon which the correct explanation rests were discussed in the chapters beginning with perception, memory, and imagination. All centrally initiated imagery is ultimately derived from antecedent sensory sources, and like its sensory precursors it all tends to be converted sooner or later into motor activity. In asking how ideas come to set up movements therefore, our only problem is how particular ideas come to be followed by particular appropriate movements. The tendency to produce motor changes of some kind is an innate characteristic of all imagery processes. In this sense all our ideas are motor. Or, as certain psychologists would put it, all consciousness is conative. The real question is, why an idea should ever *fail* to produce a movement, and we anticipate our discussion so far as to say forthwith that such failure is due simply and solely to the inhibiting effect of some other sensational or ideational process. which is also struggling for motor expression.

This assertion finds interesting confirmation in the disposition of many children to think out loud. The absence of inhibiting ideas results in the expressive movements of enunciation. Imperfect inhibition is shown by persons who move the lips when absorbed in thinking or reading, without actually speaking. "Muscle reading" depends upon the same principle. If one think intently of a hidden object, it is practically impossible to avoid making movements toward it. By means of these slight movements the "operator" is enabled to locate it. Acts of this kind are sometimes called ideo-motor and are cited as evidence of the normal form of volition, *i. e.*, an idea directly followed by action.

Neural Habit and Ideational Control.—The explanation of the fact that such ideas are able to call forth the movements desired seems to rest wholly upon the principle of neural habit. The appearance in consciousness of the idea of the movement means in the first instance a re-excitation neurally of a certain central portion of a sensory-motor arc. Granted that such an excitation takes place, whatever its neural antecedents, we can feel sure, from the polar nature of nervous currents, that it will ultimately produce motor effects. The ideational process simply reinstates, as we have so often noted heretofore, the latter portion of a previous sensory-motor process. This relation is exhibited graphically, although with extreme simplification of the actual facts, in the accompanying diagram (figure 62), in which *SSSM* represents

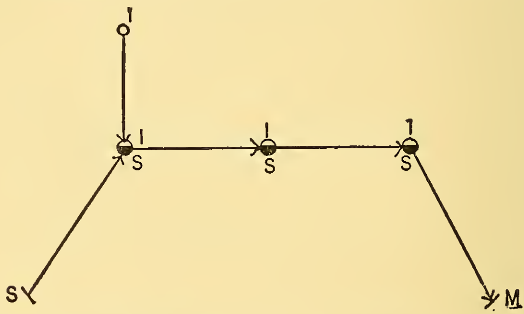

FIG. 62. The pathway from *S* to *M* represents the course of a *sensory* stimulus passing from a sense organ to a muscle through cortical centres. The pathway *I* to *M* represents the course of an *ideationally*, or *centrally*, aroused neural activity traversing in part the same pathway as the previous sensory stimulus, and issuing in the same muscle.

the course of a sensory impulse forward into a coördinated reaction; and *IIIM* represents the same reaction, but in this case with its initiation in an image or idea. If it be admitted, then, that we have already discovered the essential steps in the process by which movements become coördinated in reference to certain sensory stimuli, it follows inevitably from the considerations which we have brought forward in earlier chapters that a re-excitement of the central regions connected with these sensory-motor coördinations will, unless inhibited in some definite manner, reproduce the same motor reactions. Ideas are the conscious factors in such central excitations. The idea of a movement is, neurally considered, the beginning of that movement. By means of association, ideas which are in any vital way connected with movements may ultimately be used to produce them.

Feeling, Emotion, and Sentiment in Volition.—Although but little explicit attention has been called to the matter, it must be obvious that feeling, emotion and sentiment are tremendously important determinants of volition. Many of the emotions we have found possessed of native motor expressions. Strong feeling of every kind is distinctly motor in tendency. Pleasure and pain are cardinal factors in guiding conduct. While all this is admitted, and, indeed, insisted upon, it must not be forgotten that in so far as volition is a process in which we anticipate actions, it must involve perceptions and ideas. It is these elements in our feelings and emotions by means of which we succeed in making appropriate and effective responses to given situations, rather than random ones. Emotion and feeling are indeed dynamic, but they have definite direction. We are afraid of some *specific thing*. We are covetous of some *particular honour*. The object toward or away from which we feel impelled is represented by some perception or idea, and it is these elements in the emotion which give it effective *direction*. To say, then, that an emotion or a feeling or a sentiment may determine a voluntary act, is only to say that a certain form of perception or idea may do so. It is therefore unnecessary to add anything on this score to our previous account of the elementary features of volition.

The Learning of New Coördinations by Adults.—It will be profitable to pause a moment at this point and examine certain peculiarities of adult processes of learning. It has sometimes been maintained that adults in learning any new coördination avail themselves, first, of the "resident" imagery, *i. e.*, that which represents the kinæsthetic sensation of the moving part; and that after the coördination has been established they resort to "remote" imagery, *i. e.*, that which represents the sensory effect of the movement upon sense organs other than those in the part of the body moved. There is undoubtedly a measure of truth in this formulation, but it requires some modification before we can accept it. If we examine the facts in the case of acquiring a new series of coördinations, such, for example, as playing the piano, we find very great individual variation, but in general the process is of the following character:

We first employ the visual impression to guide us as to the proper position for our hands. We then attempt to secure a distinct tactual-kinæsthetic impression of the hand and fingers when their position is correct for securing certain results, *e. g.*, playing the scale. For a long time the proper playing of the scale requires the control of both the visual and the tactual-kinæsthetic processes, one of which is resident and one remote. Moreover, it is visual and kinæsthetic sensory elements, rather than images or ideas, which are employed at the outset. After the coördination is fairly well established, the sensory control may be disregarded and either kind of imagery may then be employed to discharge the movement. As a matter of fact, when this stage is reached another and more remote form of imagery generally steps in and takes command—if, indeed, it has not participated earlier. Playing commonly is done from a printed score, and always, save upon a few humanely constructed instruments, produces sound. When the control of the finger movements is highly developed, the sight of the score, the visual image of it, or the auditory image of the sound of the composition, may serve entirely well to bring about the movements, which seem to "take care of themselves," as we say.

It appears, therefore, that the change in the form of imagery which we employ in the control of our movements is not to be described merely in terms of a transfer from resident to remote. The sequence of events in the most highly developed cases seems to be of this character, *i. e.*, resident-and-remote-sensations immediately connected with the movements, resident-and-remote-ideas immediately connected with the movement, remote-sensations-and-ideas mediately connected with the movement. The clue to the several steps in the onward progress will generally be found in inquiring where one's interest is located at the moment. So long as this is necessarily in the movement itself whose control we desire, the psychological elements will all be found gathered about this. Some of them will be resident, some remote. The moment the movement is mastered, however, interest generally moves forward to the application of the movement in some larger undertaking, and at this stage the mental elements which refer to the movement and bring it into operation may be only remotely connected with it. But the connection is, nevertheless, real, however seemingly remote, and the appropriate muscular activity never follows an idea, unless one's previous experience has in some fashion or other established a nexus of the habit type. The functional organic connection between such ideas and their motor expressions is just as genuine as that displayed by any other kind of ideo-motor fusion. It is only from the standpoint of the outside observer, who either does not know or else neglects the antecedent development, that the two things appear remote and disconnected from one another.

The Disappearance of Consciousness From Controlled Coordinations.—We must emphasise once again one of the rudimentary facts about the establishment of motor control. We have repeatedly had occasion to remark that consciousness tends to disappear the moment that physiological conditions are established adequate to the supervision of the various motor adjustments necessary to the organism. The case of volition affords the conspicuous and typical instance of this disposition. When a special form of motor activity is needed, attention steps in and the psychophysical processes which we have just described coöperate to effect a satisfactory coördination. This coördination is then deposited, so to speak, in the nervous system in the form of a habit. When further organic demands arise, this habit is ready at hand and capable of being employed with a minimum of conscious control. In this way consciousness is ever pressing onward, supported by the reserve forces of habitual coördinations, which can at any moment be summoned in the conquest of new realms. Volition has thus no sooner established a habit, than it turns about and employs the habit as a tool in the construction of larger, more extensive habits.

In adult life almost all of one's important decisions are carried out in a practically automatic manner by established coördinations of the habit type. Writing, reading, walking, talking—what is there that one does—which does not in the last analysis reduce to the use of acquired habits; and for the actual execution of the muscular movements the most fleeting and inconspicuous cues are often adequate, because of their habitual character. The ethical and pedagogical importance of this absolutely fundamental nature of habit, upon which we enlarged in chapter III, must be obvious. When viewed in this way one sees, too, why volitional processes seem at first sight to have so much of the miraculous in them. Why and how should the mere flitting of an idea through my mind lead to such remarkably complex and well-adapted acts as the singing of an aria, the paying of a bill, etc? The answer is literally impossible, unless we turn back and trace the progress step by step through which the coördinations have become established and come into functional connection with particular ideas. When we have made such an approach to the problem as this, the solution is seen to involve definite and intelligible laws operating in a fixed and definite way.

Volition and the Types of Imitation.—It will be recalled that we classified one form of imitation among the impulsive types of reaction. Psychologists are at variance with one another as to its instinctive nature. It will appear when we take up the discussion at this point, as it did in the chapter on instinct, that certain varieties of imitation are undoubtedly not instinctive in any demonstrable manner, whereas certain other varieties of it strongly suggest this origin. Moreover, certain forms of reaction which have been called imitative are characterised by the mere repetition of a movement regardless of its immediate provocative. Imitation in the more customary and limited sense applies properly to cases in which the action of some second person is intentionally copied—in purpose if not in fact. It must also be added that whereas imitation in the common implication of the term applies to acts done consciously and with definite intent, certain imitative reactions are apparently executed without any explicit purpose and with a minimum of conscious supervision. These complexities in the modern meaning ascribed to the term "imitation" need to be borne in mind, if one is to avoid confusion. This is especially true when one is referring to such acts for light upon the mode in which voluntary control is attained.

Primary Imitation.—The repetition of monosyllables, such as da-da, which many babies indulge in long before they begin to use vocal sounds intelligently, may serve to illustrate the first type of imitative acts. Sometimes these sounds are closely similar to certain words which the child may have heard. But it seems questionable how far the term imitation can fairly be applied to acts of this character. In any case they belong to the form of activity which Mr. Baldwin has dubbed "circular reactions." The articulatory movements, once they are made, produce auditory and kinæsthetic sensations. These sensory stimulations drain out again through the already pervious pathways leading to the same muscles, and so the process goes on more or less indefinitely. Such employment of the muscles is, within the limits of fatigue, *per se* agreeable, and we must suppose that even though the function of consciousness under these circumstances is largely reduced to that of a spectator, it nevertheless, as spectator, indorses the on-going activity and serves thus in some measure to fix in the habit form the neural-motor groupings which are concerned. Certainly, when one can get the child's attention, the movements are commonly checked for the time being, thus suggesting that in some way they are after all in a measure dependent upon the conscious processes.

Characteristics of Conscious Imitation.—Conscious imitation of copies set by other persons and felt by the child to be models, which he strives to duplicate, constitute a later, more complex, and possibly more important form of action. Indeed, Mr. Baldwin will have it that in this condition we meet the real beginning of volition, and to it he assigns the convenient designation "persistent imitation." The term "persistent" emphasises the fact that such imitative movements are made again and again in the face of partial failure, until success is finally achieved.

It must be remembered, however, that many consciously imitative acts are not repeated, or at all events are repeated after long intervals and without any reference to their previous performance. Thus, a child may make a definite effort to repeat a new word that he hears his parents use. His failure may be ludicrous and it may be weeks before another effort is made. In the case of older children and adults persistent imitation is an omnipresent phenomenon. If one boy in a group jumps over a fence, every other boy feels himself under obligation to go and do likewise; and those whose efforts are below the accepted standard of excellence promptly devote themselves to correcting the defect, adopting for their pattern, so far as possible, the achievement of the leader of the group. In social life one large mass of people is always engaged in attempting to follow the pace of the leaders. Each smaller group has its own chief, who again sets the pattern for that group, and in no realm of life, whether æsthetic or religious, practical or theoretical, are we ever wholly free of the disposition to imitate. What is the actual process involved in the more rudimentary expressions of this deep-seated human tendency?

The process may take place under either of two forms, seemingly distinct, but fundamentally alike. The imitation may be directed to repeating certain movements *e. g.*, the gestures, intonation, or facial expression of some other person, or it may be concerned with the production of a result similar to some standard object set up as a model, *e. g.*, a letter, or a figure, in which case the actual movements employed may vary considerably from time to time without seriously impairing the integrity of the copy. Although this instance of reproducing some visible outline is more highly evolved than certain of the earlier forms of conscious imitation, it will serve satisfactorily to exemplify the basal facts about such activities and their relation to developing volition. It will be seen, moreover, that they are distinguished in one respect only from the type of developing coördination which we first described, *i. e.*, in the presence of an external standard with which their results are compared.

A young child learning to write is commonly given a copy, and then the teacher takes a pen and demonstrates how it should be held, and how the writing movement should be made. When the child essays his imitation the usual result is something of this kind: The pen is grasped with needless severity, the brows are wrinkled, the muscles of the body are tense, the breathing is spasmodic; often the mouth is open, and the tongue is discovered to be making futile movements in secondary imitation of the hand-tracing. Evidently the stimulus has resulted, as in other cases which we have examined, in an overflow of nervous energy into muscles which are largely irrelevant to the success of the immediate enterprise in hand. The product of this effort is compared with the copy, its failure to comply with the original is noted, and another effort is made. Or the repetition may be forthcoming simply because the act itself is agreeable, and with a splendid disregard of any disparity between copy and original. In other cases, candour compels one to admit, the next attempt is made under the influence of some one of the various forms of suasion of which the teacher may be master. When the activity goes forward of the child's own initiative, however, and when he is left more or less to himself, he slowly manages to improve his work both as regards faithfulness of portrayal and as regards the elimination of useless movements. Now this result is achieved in much the same manner as already described in connection with our illustrative baby and rattle, so that however fundamental these conscious imitative processes may be in putting the child in touch with his social surroundings, the method of procedure adds nothing essential to the forms we have already studied.

CHAPTER XXI

RELATION OF VOLITION TO INTEREST, EFFORT, AND DESIRE

The foregoing chapter has brought to our notice certain of the rudimentary features of voluntary action. We have traced the general development by means of which impulsive and other primary forms of movement set up sensory excitation, which is then appropriated and converted either directly, or indirectly as imagery, into a mechanism of control over the movements. We have also remarked the tendency of attention in volition to produce the semi-conscious, or non-conscious, quasi-automatic acts which we call habits, and its further tendency to pass on, as soon as such habitual coördinations are established, to the formation of yet other habits. In the present chapter we must examine certain of the wider and more general characteristics of volition, and especially its relations to effort, interest, and desire.

Theory of Selective Attention in Volition.—When we described in the last chapter the manner in which choice is accomplished by means of the selective activity in attention, which rejects certain ideas and clings to others, we made no special attempt to explain *why* attention displays these preferences. Indeed, no ultimate explanation can be given for these decisions, any more than an ultimate explanation can be given for the constitution of the sun. But in a proximate way we can get at the reason, and we find it is connected very closely with our whole view of the nature of organic life and the significance of mind for living creatures.

Spontaneous Attention.—In our account of attention, early in the book, we emphasised the basal nature of what we called spontaneous or non-voluntary attention, *i. e.*, attention directed freely and without compulsion in a manner expressive of the mind's inner interests. We have recently been discussing a parallel fact in the motor region under the name of impulse. When we put these two groups of considerations together, we find that the organism manifests, both on the psychical and the physiological sides, definite projective tendencies. Certain kinds of movement, certain kinds of objects, appeal to us at once natively and without reflection. We come into the world, so to speak, with a bias already favouring certain experiences at the cost of other possible ones. Moreover, we vary from one another very markedly as regards the special directions of this bias. So far, then, as choice comes down to a question of attention to ideas, we may be sure that by virtue of this spontaneous characteristic of attention certain ideas will from the first be given preference over others.

If we take the situation on the level of our own adult consciousness, we find that we are naturally disposed to attend to those ideas which immediately interest us, rather than to those which do not. But when we ask the further question, *why* they interest us, we can only point again to the spontaneous and impulsive nature of attention. We get back here finally to the admission that both the hereditary and the personal history of each of us has produced differences in our impulsive and spontaneous modes of acting which we all recognise in one another, and for which we can offer no detailed explanation. Fortunately, however, we can point out somewhat more intimately certain of the fundamental features of interest as a mode of consciousness, and this we may briefly undertake.

Interest.—Interest has sometimes been treated by psychologists as one of the intellectual feelings. In the case of mere curiosity the reason for this is fairly obvious. Indeed, we mentioned curiosity as one of these feelings, when we were analysing affective consciousness. But if we consider the type of interest which we feel in an absorbing pursuit, a game, an experiment, or a business venture, then we recognise that such interest, however truly it may display affective characteristics, is a phenomenon which belongs conspicuously among the conative processes of mental life. To bring out the point it is sometimes said that "we may *give* attention, but we always *take* interest." This statement discloses the positively active, self-expressive, self-assertive nature of interest. We have observed that attention is always in point of fact an expression of organic activity, but the subjective difference between listless attention to a tedious subject and the kind of attention we give to things which interest us is unmistakable.

Stimulus of Interest.—Like other psychical experiences, interest always has some stimulus. However completely absorbed we may conceivably become in our own merely subjective feelings, interest always has some *object* to which it refers, and the object is definitely recognised. This gives us at once a point of identity and a point of difference between interest and pure racial impulse. Both are projective, both are dynamic, but one has a *recognised* object toward which it is directed, whereas the other at first has not. Spontaneous attention may be a primary mental activity. Interest is always secondary. It is a conscious phenomenon attaching to objects of which we have already had some experience. When we seek to discover what attributes an object must possess in order to be interesting, we are forced back at once upon uninstructive generalities. We may say, for example, that all objects which call out emotion are likely to be interesting—in a broad meaning of the word. But we have instantly to admit that in the main we cannot say in advance of the actual test with each individual whether an object will call out an emotion or not. The peculiarities of personal constitution, the vicissitudes of personal history, the reigning mood, these and a thousand other factors may all enter in to modify the reaction.

In the same general way it is sometimes said that strange things are interesting. But this statement also has limitations of a serious character. Things may be so strange as to be utterly meaningless to us, and in such cases we are essentially oblivious to them. The behaviour of primitive peoples confronted for the first time with the paraphernalia of civilisation is replete with illustrations of this fact. Again, the affairs of our daily routine are said to interest us, *because* we are accustomed to them. If this assertion of interest in routine were always true, which, unfortunately, perhaps, is not the case, the explanation offered for the fact is evidently in flat contradition with the implication of the previous instance of interest in strange things. Indeed, considered impartially, it is difficult to discern any reason why either strange or familiar things should be *per se* interesting simply by virtue of their familiarity or strangeness.

The moment we accept the view that the individual, as born into the world, has certain predispositions toward spontaneous attention in given directions, just as he has native impulsive movements, we instantly get a standpoint which renders intelligible the different forms of interest which different individuals reveal, even though we may be quite unable to account specifically for the special interests which any particular person evinces.

Attention and Interest as Organising Activities.—When we recall the fact that attention is essentially an organising activity, bringing into relation with one another the various objects toward which it is successively directed, we can readily appreciate how the existence of spontaneous attention should, at a very early date in the life of each of us, serve to establish a positive and systematised predisposition to emphasise certain interests and obliterate others. To the child of strongly artistic bent everything is absorbingly interesting which touches in any way upon art, and all other interests tend to become subservient to this, on pain of absolute suppression. With most of us spontaneous attention runs out to welcome a miscellaneous range of objects and experiences, and the development of a single paramount interest is often slow or altogether wanting.

There is nothing incompatible (*crede experto*) in a boy's being thoroughly interested in both fishing and geometry. The incompatibility arises only when one interest assumes the right to control the other permanently, or at improper seasons. While spontaneous attention is, therefore, primarily responsible for the differentiation of our interests, the subsequent course of development involves the coördination of these interests with one another. In this process we call into play in varying measures our reflective abilities and thus elaborate, each for himself, a certain hierarchy of interests. Not that this undertaking is, perhaps, ever accomplished with a definite recognition of what is in progress. But as adults we can all discern that such a process has actually been going forward in us. In childhood our interests were chaotic, disconnected, unordered. In maturity they are fairly well marked out and related to one another. Many of the adolescent and childish interests have disappeared altogether. The interests in toys and in dancing may have evaporated. In their stead we find interests in the home, in our professions, in certain kinds of amusement, etc.

It may be said that, after all, this elimination and precipitation of interests which we find characterising adult life is again explicable in the last resort only by the action of spontaneous attention. This is probably true in so far as it means that in the last analysis the explanation of what vitally interests us is to be found in our native constitution. But in distinction from the cruder expressions of this spontaneous attention in childhood and infancy, the conditions in later life reveal a much more reflective and rational exercise of the function. Moreover, we have at this point to remember once again that man is from beginning to end a social creature; he is constantly under the pressure of social influences; and a large part of the explanation for the special directions which attention finally does take, in building up the interests of each one of us, will be found to lie in the effects of the social rewards and punishments meted out to us by our companions.

Put a child into a group of religious ascetics to grow up and the chances are that the only interests which will really get opportunity to live and thrive will be those which are conformable to the ideals of such a community. On the other hand, let him be cast among pirates, and a totally different group of interests will blossom forth. This is not because the child is a hypocrite. It is simply because one of the most universal of all objects of spontaneous attention is found in the attitudes and actions toward us of those among whom we live. A certain amount of repression from them may not stifle a vigorous interest. But many a taste which might in a kinder social climate take root and bring forth rich fruit, dies ere it is fairly planted, because of the frosts of social disapprobation.

Interest and Native Talent.—Highly important is it both practically and theoretically to recognise the existence of specific natural talents. These are often hereditary, but not infrequently they crop up unexpectedly in soil apparently most unpropitious. They represent the directions in which the individual is prepared to offer society his most effective service and for this reason, as well as because in pursuing these lines he can enjoy the happiest and most wholesome life, such talents ought to be cultivated. We speak of course simply of those which are not clearly vicious in tendency. Such gifts are as various as the facts of life itself, but familiar ones are the following: The talent for mechanics and the engineering sciences in any one of their branches from carpentry and metal work to bridge construction and architecture: trade and commerce, the management of people, whether for industrial, political, or military purposes: music, drawing, painting, and the plastic arts. Medicine, law, the ministry, and teaching, all require peculiar gifts, possessed in marked degree by certain individuals, not to mention the career of letters and scientific research. To these capacities, many of which are considered to be primarily masculine, women add talents for more purely domestic callings.

Clearly certain of these capacities are of a kind to appear only in adult years. They are not necessarily less native for that. Certain others appear in childhood and it is these which require especially careful nurture. At first these talents are evinced as interests rather than as accomplishments. It is this fact which renders their mention here appropriate.

Interest a Dynamic Phase of Consciousness.—Interest evidently represents the spontaneous, dynamic side of our psychical make-up. The self is in a very true sense reflected in one's interests. It would be truer to say that a person's emotional reactions *disclose* his interests than to say, as is occasionally done, that his emotions *call forth* interest. Furthermore, in the light of our preceding analysis, it seems clear that the interest which we are said to feel in strange things finds its basis in the expansion of our *selves.* Not the absolutely strange thing do we find interesting, but the thing familiar enough to be vitally connected with our past experience and still novel enough to be felt as a definite enlargement of this experience. As we saw long since, all such expansive states of consciousness are, other things equal, intrinsically agreeable, and they afford a definite appeal to the accommodatory function of attention. The interest of the customary, the habitual, has a precisely similar basis. It is only as we *find ourselves* and feel the experience as a real *expression* of ourselves that routine is interesting. Whatever is *purely* mechanical in it is simply disregarded in consciousness.

The artist is the man above all others to whom routine is utterly delightful, not because it is easy, not because it fosters the caprices of his indolence, but because it calls into action the very heart of the man himself. Moreover, let it not be overlooked that the artisan or the professional man who thus delights in his work for its own sake is in so far an artist—the carpenter, the engineer, the lawyer, and the teacher. Each is making, or doing, that which gives overt expression to his own inner nature. So far as routine is disagreeable, apart from sheer physical fatigue, it is because it does not call out an expression of the real self, nor of its keener interests. It is executed in spite of those interests, and against their violent and increasing protest. Let it be understood that we are not here discussing the ethics of routine, the righteousness or unrighteousness of our feelings, either of satisfaction or disgust. We are simply pointing out the conditions under which routine is interesting or otherwise, and showing their connection with the sources of interest in the strange and the novel.

Moral Decisions.—To many persons moral decisions which are made with great effort and under the influence of active conscience appear to be the most genuine expressions of the will, the most typical instances of volition. Such experiences are felt to reveal more intimately and deeply than any others the real nature of our personal character and power. The man of strong will is thus the man who can wrestle successfully with temptation, feeling to the uttermost the poignancy of his desire, but still opposing to it the irresistible force of his ideal. It behooves us, in view of this widespread feeling about the significance of decision with effort, to consider the important facts in the case. Are we, indeed, in these decisions made conscious of some inner and unique constituent of the mind which on other occasions is wanting, or at all events lurks so surreptitiously in the background as to defy detection?

Volition and Effort.—Broadly speaking, there are three main forms of voluntary processes involving the consciousness of effort. We neglect for the present, at least, the case of mere physical effort, such as is involved in lifting a heavy weight. (1) We are conscious of effort when we attempt to keep our attention upon some tedious and uninteresting subject. (2) We are also conscious of effort when we must make some momentous decision, where a correct choice evidently involves a large number of complex considerations which we are not certain we have properly in mind, or when we are in doubt as to our possession of the precise facts. Such cases need not implicate our own personal desires on either side. Complicated financial problems often illustrate such situations. In both these cases, however, the feeling of effort does not attach primarily to the fact of *choosing* among the alternatives. It is a feeling of strain and tension which we refer to the whole intellectual process. It partakes more nearly of fatigue than of any other single nameable experience of a familiar kind. (3) The third type of case is represented by the moral crisis, in which we find ourselves beset by some immoral but alluring project that thrills every fibre in our being with passionate desire. To this tempest of evil inclination there is opposed only the pale, uninteresting sense of duty; and yet, little by little, conscience makes itself felt, and when the moment for decision comes, we gather ourselves together and, throwing the whole power of our will into the struggle, we throttle our passion and save unsullied our fidelity to the right. Experiences of this kind have time out of mind been the mainstay of defenders of the freedom of the will. Here, they say, is an obvious and undeniable case where the will comes in to bring about action in the line of the greatest resistance, instead of in the line of least resistance, as the mechanical philosophers insist must always occur. We must decline to enter upon the question of the freedom of the will, which metaphysics has preëmpted, but an analysis of the psychology of effort we may profitably undertake.

Analysis of Effort.—Two antagonistic theories have been maintained about the feeling of effort in such a case as that of our last illustration. Certain psychologists have held that under such circumstances we are immediately and unmistakably aware of our own will. Others insist that accurate introspection discloses to us nothing peculiar to experiences of this character, beyond the consciousness of many sensations of muscular strain, which originate from the tense condition of the voluntary muscles, especially those connected with respiration. We must distinguish very sharply, in dealing with this disagreement, between the *fact* of *volitional activity* and its *mental representative* which informs us directly of this activity. Undoubtedly crises of the kind mentioned do involve volitional activities of the most basal character. Undoubtedly, too, they do reflect in the most exact manner the real moral nature. But it does not follow from this that we are conscious of a *conative element* in consciousness akin, as an element, to sensation. The issue here is one of introspective accuracy, and on the whole the evidence seems to favour the second of the two theories we have mentioned. Our consciousness of effort is a consciousness of the emotional kind, in which a very large group of sensations of muscular tension is present. Commonly, too, the affective tone of the experience is distinctly unpleasant.

Consciousness of Mental and Moral Effort an Emotional Experience.—If we call to mind what reactions we customarily exhibit under circimstances of the kind suggested by our illustrations, we find that our breathing is checked and spasmodic, our faces set, our brows contracted, our hands clenched, etc. All the muscular attitudes contribute their sensory increments to the total consciousness of the moment, and observation certainly shows that our sense of the effort involved in a moral decision runs essentially parallel with the intensity of these motor reactions. When the muscles are quiescent, we have no keen sense of effort; when the *feeling* of effort is strong, the muscular tensions are always in evidence. We have asserted that the consciousness of effort, so far as it belongs to ethical decisions, appears when *desires* are opposed to *ideals*. We shall discuss the nature of desire in a moment, and we shall then discover confirmatory facts tending to bear out our contention that ordinarily the feeling of mental effort (disregarding the consciousness of fatigue) is itself essentially emotional. Its general nature can, therefore, be identified with that of the other emotions which we have already discussed. It is a phenomenon connected with the mutual inhibition of competing motor tendencies. Until the moment of decision has arrived, these impulses are dammed up in the organism itself, and we meet the consequences in the form of tense motor contractions. When the choice has been made, the inhibitions fade away and coördinated movements expressive of the decision are promptly executed. It has already been suggested that ultimately the utility of these muscular rigidities is to be found in the added stimulation which they furnish us, augmenting thus the weakening momentum of our onward moving selective activities. Their function would thus be found, like that of the accommodatory movements in attention, in their contribution to the *amount* of conscious activity available.

After all, it must not be forgotten that however much our *consciousness* of effort may depend upon certain sensations of strain and tension, the *psychical import* of the feeling is essentially that which the most spiritualistic psychologists have assumed. Effort means conflict within the self, within consciousness; it means lack of harmony among our ideals and interests and aims; it indicates imperfect systematisation and coördination among the mental processes themselves. The *act* by which the dominant system of interests and ideas manifests its sovereignty and executes its behests is the "fiat" of our last chapter. All this is perfectly compatible with our finding it distinguished by certain peripheral sensory conditions by means of which we come subjectively to know of it.

Volition and Impulse.—Although we readily recognise and admit that the volitional processes in childhood are, in their origin, dependent upon native impulses, it is not so obvious that adult conduct is in the same manner bound up with impulse. Nevertheless, this is the fact, as we shall now see. Indeed, the statement is often made that the *development of volition is neither more nor less than a process of reducing our impulses to order, and that a mature character is simply one in which the impulses are thus subordinated to some systematised principles.* Instead, therefore, of the conception that a developed will or character is one in which all primitive impulses have been extirpated or repressed, we have the conception of these impulses as continuously operative, but operative in a rational and coherent way, rather than in the chaotic fashion characterising childhood and infancy. This view is unquestionably correct in its general implications, and an examination of the nature of desire will assist to exhibit the fact.

Volition, Desire, and Aversion.—Large portions of our daily acts occur with a minimum of conscious supervision and volition. This fact we have had repeated occasion to emphasise, and we have found its explanation in the establishment of complicated habits reflecting our customary routine. There is, however, a highly important residuum of acts in which our wills are most vividly enlisted. This group of acts appears whenever we step outside the beaten path of habit, or when habits are threatened with violation. The clerk who is tempted to cut his work in order to see a ball-game, the young man who is considering an advantageous offer to change his occupation, the school-boy whose attention to his books is diverted by the alluring cries of his truant comrades, all three afford illustrations of the workings of desire. Now, if we pass in review the various things which we seriously wish for ourselves, we shall find that the vividness of the desire is proportional to the extent to which some one or more of our rudimentary impulses and emotions are enlisted. Objects which do not appeal to any of these primary instinctive reactions do not call forth intense desire. At most, we sporadically "wish" for such things. But the wishing is of a relatively cold-blooded, incidental kind, utterly distinct from the hot, passionate, craving which we feel for objects of the first class. Moreover, along with the desire, which is the positive aspect of the phenomenon, must be mentioned aversion, which is like desire in its emotional character, but which discloses to us the negative phase of the process.

The experiences in which we are conscious of the definite yearning of desire, or the positive distaste of aversion, are, therefore, those which directly or indirectly call into activity such impulses as play, love, sympathy, grief, ambition, vanity, pride, jealousy, envy, fear and hate. Without these or their congeners to colour the occasion we rarely meet with anything which we could justly call either desire or aversion. It hardly needs to be pointed out that in many cases desire and aversion involve several such emotional factors. Pride and love may thus be conjoined, sympathy and grief, fear and envy.

Although the term *desire* is generally applied to the more intellectualised forms of craving, we must add to the list the so-called appetites. Bain has classified these as the appetites of hunger, thirst, sex, sleep, repose, and exercise. They are all immediately concerned with recurrent organic conditions, but they may readily be developed in such connections as to take on a relatively ideal character. Whether or no they come to occupy a place coördinate with the other forms of desire, depends upon the degree to which they chance to secure such an integral connection with our general intellectual life and character.

Society has been historically organised in large measure around the appetites of food and sex, and in consequence the institutions amid which we live and the ideas which come to us through them are coloured from beginning to end with influences of such origin. The family and the institution of property will together serve to suggest the innumerable ramifications of influence radiating from these two appetites in human life.

Desire.—In its most overt and definite manifestations desire appears, therefore, to be a form of consciousness in which the blind impulsive character of a pure instinct is modified by a knowledge of the object which will satisfy the impulse. There is on this account, however, little or no lessening of the restless disposition or craving to express the impulse. Desire accordingly gains its power and vivacity from its impulsive nature; it gains its rationality from experience. After our emotions and instincts have been once expressed, we know in the future what to expect of them. Desire is the conscious condition which represents this knowledge of what an emotional impulse means. It is the craving unrest for the object which we know will give us pleasurable satisfaction. To be sure we desire some things which we know will cause us pain, but in such cases it may be fairly questioned whether there is not always, save in occasional pathological cases of the insane type, more or less reference to some secondary or ulterior gratification. The tired mother insists on watching by the bedside of her sick child, even when others are ready to take her place and spare her the exhausting ordeal.

Aversion.—Aversion, on the other hand, is the precisely polar condition in which again we realise the significance of the object which is mentally present to us, and recognise, on the basis of our experience, that the realisation of it will be disagreeable. We consequently draw back from it and strive to shun it. Paradoxical as it may seem, both desire and aversion are apt to be dominantly unpleasant; desire, because of the *temporary* thwarting of inclination and impulse; aversion, either because of the dread of permanent thwarting of some one or more cherished and agreeable experiences, or because of some positive menace of pain. To be sure, there is often a certain exquisite delight in this discomfort of desire, as the poets have repeatedly recognised.

Basal Nature of Desire in Formation of Character.—It should be evident from the foregoing discussion that desire occupies an extremely fundamental position in the development of will and the formation of character. In the first place, the actual psychical condition presented by desire affords us a striking instance of the great salient features of the mind with which all our previous study has been concerned. In it we find elaborate thought processes at work; we find conspicuous affective factors and we see the whole onward moving conative character of consciousness brought clearly to light. Moreover, it discloses to us an epitome of the character at any given moment. What one really *desires* is the best possible index of the sort of character one really possesses.

CHAPTER XXII

CHARACTER AND THE WILL

Volition and Character.—Inasmuch as consciousness is a systematising, unifying activity, we find that with increasing maturity our impulses are commonly coördinated with one another more and more perfectly. We thus come to acquire definite and reliable habits of action. Our wills become formed. Such fixation of modes of willing constitutes character. The really good man is not obliged to hesitate about stealing. His moral habits all impel him immediately and irrepressibly *away* from such actions. If he does hesitate, it is in order to be sure that the suggested act *is* stealing, not because his character is unstable. From one point of view the development of character is never complete, because experience is constantly presenting new aspects of life to us, and in consequence of this fact we are always engaged in slight reconstructions of our modes of conduct and our attitudes toward life. But in a practical common-sense way most of our important habits of reaction become fixed at a fairly early and definite time in life.

We noticed in chapter III that the general manner of speech, the mode of dressing, purely personal manners, etc., are commonly fixed before twenty-one. The general attitude toward moral and religious ideals is likely to be gained sometime during, or just after, adolescence. Professional habits come somewhat later. Speaking broadly, however, for the average individual the dominant *tone* of his habits, social, moral, æsthetic, and intellectual, is set by the time he is thirty. By this time the direction of his desires and his interests is likely to be finally formed, and for the rest of his life he will but elaborate and refine upon this stock of tendencies.

When we recall the fact that habit depends ultimately upon the preservation of physical changes in neural tissues, we see how powerful an ally, or how frightful an enemy, one's habits may be. The man who has led a life of kindliness and sobriety not only has a fund of agreeable sentiments upon which his friends and neighbours can rely, he actually *could not* be mean and selfish and sordid without an herculean effort, for his nervous system contains imbedded in its structures the tendency to altruistic deeds.

Moral Development.—When we describe the development of character as a process in which our impulses become coördinated with one another, we have in mind a very specific course of events. Thus, for example, the little child in learning obedience to his parents may be engaged with the impulses of love, of fear, and of anger. We may suppose that the child has been forbidden to do something. This occasions disappointment and anger. Disobedience is threatened. The parents may appeal to the child's affection or to his fear of punishment in the effort to secure the desired action. The competing impulses must be ordered with reference to one another. Anger and obstinacy may carry the day, love may win, or fear may triumph. Now, whatever the actual outcome, the *set* given to character by the result is undoubted and will make itself manifest on the next occasion when obedience is at stake.

At first sight it might seem as though in such a case as that of our illustration the question were not one of *coördinating* two impulses, but rather of allowing one to suppress the other. This is the view which many good persons take of the whole course of moral education. But this theory is based on a fatal misapprehension of both the psychological *facts* and the ethical desirabilities of the situation.

If one judged simply by external appearances, one might assume that when the child yielded to the appeal to his affection, the impulse of anger was wholly rooted out. This, however, is not strictly the fact. The impulse has met the obstruction of an opposing impulse, and the act which follows involves a coalescence of the two, an ordering of the two with reference to one another. Obedience given under such conditions is far more than the mere execution of certain muscular movements. It is a mental process in which the self, with its capacities for anger and love and a thousand other emotions, gives expression to its innermost nature. The tendency to react with anger upon any thwarting of desire is a part of the make-up of the self. The disposition to show love and obedience to the parent is also an integral part of it. In giving obedience and yielding to the dictates of affection, the anger is not extirpated bodily, but it is transfigured.

All seeming *suppression* of impulses will be found to be based upon the *expression* of *other* impulses, not upon sheer brute repression. To root out a bad impulse we must set some contrary impulse to work. Moreover, in a character built up in this way the control of the morally more dangerous desires becomes a source of increased richness and power in life. Tennyson expressed this truth when he said

> "That men may rise on stepping stones
> Of their dead selves to higher things."

Only one who has really suffered can truly sympathise with grief. Only one who has been really tempted and tried can be morally altogether reliable.

The Will.—When we bring all our considerations together, it becomes obvious that the proposition from which we set out early in our work is true in a very wide and deep sense. Mind we have found to be, indeed, an engine for accomplishing the most remarkable adjustments of the organism to its life conditions. We have seen how the various features of cognitive and affective consciousness contribute each its quota to the general efficiency of the reactions which the organism is able to make upon its surroundings, physical and social. We have seen finally that in the will we have the culmination of all these activities of control. But it must have been observed that we have not found any specific mental element or event to which we could give the name *will.*

No, the term will is simply a convenient appellation for the whole range of mental life viewed from the standpoint of its activity and control over movement. The *whole mind active,* this is the will. To say that there is no such thing as *the* will (a statement which troubles many right-minded persons) is simply the psychologist's perverse way of saying that mentally there is nothing *but will.* There is no specific mental element to be called will, because all states of consciousness are in their entirety the will.

We have seen this doctrine justified in the last two chapters, wherein we have discovered volition concerned with impulses, with pleasure and pain, with emotion, with ideas, with sensations, with memory, with reasoning, and with every form and type of mental operation. We have observed the evolving control beginning with the mere mastery of movements, passing from this to more and more remote ends, for the attainment of which the previously mastered movements now available as habitual coördinations are employed, until finally we find the mind setting up for itself the ideas which we call *ideals,* and by means of these shaping the whole course of a lifetime. What these ideals shall be for any of us depends upon the operations of interest and desire, and these in turn depend in part upon the sort of tendencies which we have inherited, and in part upon the forces of our social and physical environment. We may prate as much as we please about the freedom of the will, no one of us is wholly free from the effects of these two great influences. Meantime, each one of us has all the freedom any brave, moral nature can wish, *i. e.,* the freedom to do the best he can, firm in the belief that however puny his actual accomplishment there is no better than one's best.

Training of the Will.—A deal of twaddle is sometimes indulged in as to the training of the will. The will is spoken of as though it were a race-horse which once a day requires to be given its paces about the track. What is obviously in the minds of persons who discuss the question in this way is the wisdom of some form of moral calisthenics, *e. g.*, self-denial, constructive and aggressive altruism, etc. Now, it is not necessary to enter into an extended argument upon this special recommendation, although it seems evident that apart from a deep moral interest in the thing done it could only produce moral prigs. If the moral interest is there, the artificial gymnastics will be superfluous. Life is rich in opportunities for larger and more intelligent kindliness. But disregarding this form of moral discipline, the development of volition evidently is not a thing to be hastened by any special form of exercise, because the will we have seen to be simply another name for the whole mental activity. Any purposeful intellectual occupation affords means of developing certain features of control. Play develops certain other features. Art develops volitional processes in one direction, mathematics develops them in another. So far as a well-developed will consists in the ability voluntarily to direct one's attention effectively and for unlimited periods in definite directions (and this certainly is a very basal conception), all thoughtful activity facilitates its attainment.

Healthiness of Will.—The well-trained man is the man whose mind is stored with a fund of varied knowledge which he can promptly command when the necessity for it arises; he is the man who can keep his attention upon the problem in hand as long as necessary, and in the face of distraction; he is, moreover, the man who, having paused long enough to see the situation correctly and to bring to bear upon it all the relevant knowledge he possesses, acts thereupon promptly and forcefully. Defects in any of these requirements may defeat efficient action and proclaim the actor a person of feeble or defective character.

The ignorant person cannot act effectively when nice discrimination and wide knowledge are necessary, as they often are. Even the learned person ordinarily cannot go far, provided his attention is wayward and fitful. His effort is too disconnected ever to accomplish large results. The person who is flighty and precipitate is either a genius or a fool—commonly the latter. On the other hand, the hopelessly careful person, whose life is spent in a morass of doubt and indecision, balancing imponderable considerations and splitting insignificant hairs—he, also, is likely to belong to the incompetents and inefficients. Evidently the attainment of a will which can fill all these requirements for the avoidance of pitfalls requires a training on every side of one's nature, requires a rich experience and a powerful dominant purpose running through it. All life offers such training, and our success in building up a strong, rich character depends much more on *how* we do our work than upon *what work* we do. There is no calling so humble that it may not afford scope for the expression and development of all the great human interests, if we really put *ourselves* into it, and not our mere labour.

CHAPTER XXIII

THE SELF

Before we can satisfactorily complete our sketch of the structure and function of consciousness, we must turn our attention to the facts of personality and selfhood. The normal human mind is never a mere string of states of consciousness. It is always a unitary affair in which the past, the present, and even the future are felt to hang together in an intimate personal way. In our previous study we have been obliged to examine now one aspect of the mind and now another, but we have always emphasised this partial, piecemeal character of our method, and we must now attempt to trace in bolder outlines the contours of the whole, the salient features of the concrete, actual self.

The Consciousness of Personal Identity.—Philosophers and psychologists have criticised with relentless vigour the *tenability* of our common-sense notions of personal identity. Undoubtedly the basis of this conviction which we all have that our self continues in some way the same from moment to moment is extremely precarious from a logical and metaphysical point of view. But from the strictly psychological standpoint, so far as concerns the structure and function of consciousness, personal identity is as real as memory or attention. However much our thoughts may vary from time to time, however much our opinions may alter, however much our characters may seem to be transformed as the years go by, we still feel that as a personality we are somehow unchanged. We even feel that to be true, in some degree, of our bodies, which change conspicuously as the days of childhood pass and the period of maturity and old age comes on. It is still *my* body, whether I am a child or an old man, and it has always been mine, and never for a moment capable of confusion with the body of any one else.

When we try to discern the most important psychological contributors to this sense of identity, we discover two which are evidently of radical significance. The first of these is memory. Were we not able to identify among our various thoughts those which represent former experiences of our own, it is certain that any feeling of personal identity which we might have would differ fundamentally from that which we now possess. Undoubtedly that peculiar use of the ideational process which we call *anticipation* plays an important part in this connection. The second factor is a persistent background consciousness of our own organism. When the *bodily* sensations and feelings are seriously deranged, we always experience a strange sense of uneasiness and distress which is often wholly out of proportion to any actual pain that we may be suffering. Our general sense of *bodily existence,* then, gives a fairly *constant tone* to our consciousness, and thus furnishes a certain impression of sameness or continuity. Beyond question there are other phases of consciousness which contribute their quota toward the same end. But these two are certainly preëminent.

It is a remarkable fact that our sense of the identity and continuity of our own personality is essentially unaffected by the interruptions which occur in the onflowing of consciousness. In coma, as in sleep, consciousness may, so far as we can discover, be wholly suspended. Yet upon its return it once more claims its own from out of the past, and under such circumstances it ordinarily manifests no disturbance whatever of the sense of personal identity.

Subject-Object Nature of Consciousness.—If we examine from a more critical and reflective point of view the implications of consciousness for the concept of the self, we come upon certain suggestive facts. To be conscious of an object involves not only some *mental presentation* of the object, but also some *subject* to whom it is presented. Con—sciousness (knowledge over against something, *for* some one) has no other possible meaning than just this. Indeed, so irrefutable does this idea of consciousness appear to be, that it has but rarely been called in question, although many of the inferences which have been founded upon it have been severely, and often justly, attacked.

This fact of the bipolar nature of consciousness has been the basis of many doctrines and has been designated by many different terms. Thus, James speaks of the self as "knower" and "known," of the "I" and the "me." Kant recognises the *empirical self* and the *pure Ego*. There are advantages and disadvantages attaching to each of these terms, and there can hardly be said to be any accepted usage. The reader is, therefore, free to accept that which best pleases him.

Meantime, it must be clear that all of our descriptions and analyses of the foregoing chapters have had primarily to do with the *object half* of consciousness, the *content side* of the mind. Perceptions, images, emotions—the things we are aware of—all belong to this objective phase of consciousness. To be sure, we could not apparently be aware of such experiences were it not for the subject phase of the mind. But once we have admitted the *reality* of this subject factor, we seem to have done all we can with it. It persistently avoids direct observation, because, forsooth, it is itself the observer.

If we regard the self as characterised by these two indissoluble aspects, and inquire what then becomes of personal identity, we have to admit at once that there can be no unchanging nature in the *object* side of consciousness. The contents of consciousness are constantly undergoing alteration, and we noticed in an earlier chapter that we probably never have exactly the same thought twice. Identity of any thorough-going kind is thus out of the question here. Of the subject side of consciousness it seems impossible to predicate anything save its existence. Its *function,* to be sure, must apparently remain fixed. It must always be the *knower annealing* the various elements of our experience into some sort of unity. But beyond this *functional* identity, which we can *infer* with some confidence, we have little evidence as to any of its possible attributes. Clearly, then, the personal identity in which common-sense believes rests on the evidence of some of the more unreflective and immediate influences such as we mentioned a few lines above.

We may remark in passing that this necessity for a subject of our states of consciousness has constituted one of the strongest rational considerations adducible in support of the belief in the soul. But it is to be said, on the other hand, that there are logically possible alternatives to this identification of the knower with the soul, so that we cannot defensibly be dogmatic even here.

Consciousness as Internal and External.—Before leaving this general topic one more distinction must be mentioned. The content, or "me," side of consciousness may be thought of in either of two ways. Thus, a perception of a cart may be thought of as *external,* in so far as it reports to me something outside my mind. But in so far as the perception is *my* experience, it may be thought of as *internal.* It is sometimes said, accordingly, that all consciousness viewed as external is essentially cognitive, knowledge-bringing; whereas, viewed as internal, it is feeling, *self*-reflecting. But it should be evident at once that this distinction is by no means synonymous with that between the subject and object aspects of mental life, as respectively the "knower" and the "known."

Development of the Consciousness of Self.—Despite the extensive study given of late to the subject of this section by Baldwin (to whom the author is indebted for certain views) and others, we cannot as yet be said to have any generally accepted theory, and the description which follows is offered tentatively as the author's present conception.

It seems reasonably certain that the distinction which the *child* at an early age makes between his own personality and that of others is as completely submerged in the vague conscious continuum of *infancy* as is the distinction between different sensations. When it begins definitely to differentiate, it seems not unlikely that the first step consists in remarking the difference which characterises the behaviour of *persons* and the behaviour of *things*. Things and persons thus get set over against one another. Things are relatively stable and fixed in their actions. Persons, on the other hand, are highly irregular and unpredictable. Of course, the child's consciousness of both things and persons is from the beginning his own private personal experience. But it may safely be asserted that there is no awareness of the self in a "self-conscious" way, until the vague apprehension is attained of *other* persons as distinct from things.

As the child gradually attains control over his movements, things tend in certain particulars to obey his impulses in a more immediate way than do persons. They can be seen, reached, touched, and moved more confidently and more regularly than persons. On the other hand, they show themselves altogether more imperturbable than persons to indirect modes of control. If the child cries, parent or nurse promptly responds. *Things* remain just where they were. Furthermore, persons show themselves able to furnish many comforting and agreeable experiences in the way of caresses, food, and clothing, which things of their own initiative rarely or never afford. The moment imitation becomes possible, persons offer the most satisfactory stimuli. What they do, can, by virtue of the similarity of structure in various organisms, often be approximated by the child. We might mention other distinctions, to which the child must respond, but these will suffice to suggest the lines along which the development takes place.

When this resolution of the objective world into persons and things is once achieved, there is every reason to think that the precipitation of self-consciousness follows close at hand, if it be not, indeed, synchronous with it. The whole process must in the nature of the case be extremely inchoate and protoplasmic in character. Nevertheless, it must contain within it the essential elements for the more elaborate differentiations of adult life. Moreover, if this be in any way a true account of the genesis of self-consciousness, it is evident that such consciousness will, from the outset, be *social* in its constitution. The child remarks certain objects which behave in a manner altogether distinct from other objects. These he comes to recognise as individuals, which he later calls persons. Something like their independence of action he comes to feel in himself. He naturally identifies himself with them, and thus gives to his first dimly recognised consciousness *of* self the *social hall-mark*. Needless to add, after what has gone before in this book, the actual *content* of his consciousness is always in larger or smaller measure social. The relations in which he finds himself are social. The criteria for the reality of many of the things which he is called upon to accept are social. Language is social. By imitation he is plunged at once into social usages, and did space permit, and were it necessary, we might trace out the whole gamut of social influences which bound his self-hood on every side. But our primary point here is that the first definite self-consciousness of the child is a consciousness in which he identifies himself in some sort with others, defines himself in terms of agreement or disagreement with others.

The fact should be emphasised, however, that the element of disagreement is quite as important, both for the child and for society, as the element of agreement or imitation. Every individual is in some sense a variant from the human norm, and in so far he is a contributor to the richness of human life and achievement. This variation may take the form of trivial peculiarities of manner and speech, of inventions of a scientific and practical character, of reforms in morals or art; or it may be embodied in the harmless enthusiasms of a crank, or in the dangerous prepossessions of a lunatic. In each and every case the individual is making his addition to the store of social possessions. In finding that his consciousness of self necessitates his projecting himself against society, we must not, then, for a moment suppose that this means that he *merely imitates* others, and so arrives at the knowledge of his own Ego.

It is in the character of variant from the norm that the genius gets his paramount significance for the social organism. Society sometimes progresses by the slow accretion of incremental changes originating from the conduct of large numbers of commonplace individuals. But the great changes which lend themselves to confident detection and identification are commonly traceable to the towering personality of some genius.

The Content of the Consciousness of Self.—Doubtless in the earlier periods of childhood (after the consciousness of self as such has once become established) the actual *content* of such consciousness is largely personal and bodily—an awareness of impulses, of pleasures, pains, and the like. But as the mind develops and a broader appreciation is reached of the general integration of human life and the physical cosmos, this self-feeling spreads out to embrace larger and larger interests. The social factor unfolds into a vivid apprehension of the picture of ourselves which we may imagine to be entertained by various persons and groups of persons. Furthermore, we come increasingly to read into the motives and characters of others the peculiarities which introspection reveals within ourselves. In a certain sense the vagueness which marks the beginning of self-feeling is never entirely lost. We come to include in our *practical* conception of ourselves so many things which lie outside of us, that the lines which separate the self from the not-self inevitably become hazy. Thus, our bodies, our clothing, our family, our friends, our fortune, our club, our church, our country—these, and a thousand similar things, get identified in a more or less intimate way with the self, which unfolds more and more to take in these widening interests. Meantime, there is always a residuum whose status is neither clearly within nor without the self.

The question may be raised whether a child growing up alone on a desert island would fail to develop self-consciousness because of his inability to follow the course of events which we have described, with its emphasis on the distinguishing between persons and things, and its further emphasis on the social nature of self-feeling. The reply—resting on speculative probability—is that undoubtedly something corresponding to self-consciousness might develop under such conditions through the operations of imagination. But the *content* of such a self-consciousness, and the order and nature of the steps in its unfolding, would certainly differ radically from anything with which we have personal acquaintance.

Ethical and Religious Aspects of the Self.—Although in a general way the consciousness of self is from the first social in its nature, it speedily takes on two *explicitly* social aspects, the moral and the religious, which warrant a few moments' consideration. Among the very earliest of our social experiences are those of praise and criticism, reward and punishment for our deeds. Parents, guardians, and associates of all kinds unite in thus furthering or hindering our enterprises. The vivid feeling for the distinction between right and wrong is thus aroused in us at a very tender age. As we come to have a definite consciousness of our own personality, we inevitably tend to array ourselves for or against the usages which have been thus imposed upon us. We come to appreciate something of the grounds upon which they rest, something of the advantages and drawbacks which attend their observance. We take as regards these matters a definite conscious attitude toward society at large and our immediate associates in particular. We evolve a distinctly ethical self, recognising certain obligations on our own part toward our fellows, and postulating a similar obligation for them in their treatment of us.

As we grow older this conception of ourselves as moral persons with duties and obligations takes on a broader and more enlightened character. We extend our sense of responsible interest from our immediate family and acquaintances to our town, state, and country, and often (among the more humanitarianly minded of us) we manage in a fairly definite way to include the interests of all mankind. Coincident with this expansion in the *range* of our moral selfhood is often to be remarked a growth in the *intelligence* of our *appreciation* of the real ethical situation. We come to detect more justly and more sympathetically both the grounds of our neighbour's moral ideals and the reasons for his occasional moral lapses, and we may become in consequence more helpful to him, as well as more valuable in furthering the general cause of moral progress in the world. Our moral self thus expands both by *intension* and *extension*.

The religious consciousness cannot ordinarily be severed altogether from the moral consciousness, yet the two mark quite distinct differences of stress which deserve separate treatment. The religious sentiments, in distinction from those of a merely moral sort, seem to involve a definite sense of *personal relationship* to a supreme, or at least superior, being. In the higher forms of religious faith this being is conceived as the incarnation of all holiness, righteousness, and truth. He is thus the one perfect companion for the highest ideal self, the one object worthy of complete reverence. Belief in such a being constitutes the essence of the most developed forms of religious faith, and around such a belief cluster all the distinctly religious emotions, such as reverence, awe, love, gratitude, and the feeling of personal confidence which we call faith.

The full mental vision of such a being, with an accompanying sense of our own unworthiness, is often the immediate forerunner of the cataclysmic experiences characterising certain forms of conversion. The whole moral and religious perspective of life is suddenly altered. We see ourselves and others in a different light, and the world takes on a new form. The frequency with which this special phenomenon is encountered during adolescence, has led certain psychologists to connect the experience with the deep-seated physiological changes which mark that period. But, however much of truth there may be in this contention,—and undoubtedly there is much,—we must still recognise the fact that sudden conversion, profound and genuine reformation, is a thing met with at all ages and under the most various conditions.

Types of Personality.—One of the most interesting tasks which the psychology of the future will have to face is that of delineating the various typical forms in which personality reveals itself. But at present such descriptions cannot be more than rude impressions of individual observers. In history and literature a few of these great types have been recognised. We meet here the mystics, the poets and dreamers, the seers, some of them fiery, impulsive personalities, others gentle, ascetic souls, but all of them, with a gift for vision as against the prosaic processes of tedious reasoning, and with varying powers of adequate expression for their insight. Then there are the scientists and scholars with a religious conviction of the worth of plodding care and the paramount value of facts. Sometimes this trait is married to fervour and emotional tension, sometimes it is embodied in cold calculating temperament. Then we find the great leaders of men, the military and industrial geniuses who compel by sheer force of personality, by aggressive capacity of hand or brain; the religious leaders who succeed in awakening the spiritual devotion and confidence of men. The average man no doubt has in him something of the various elements represented by all these great types, but they exercise a less imperious sway over him and are conjoined with capacities too weak and commonplace to stand out boldly from the mass of humanity.

Disturbances of the Self.—The consciousness of self is subject to certain striking disturbances which merit a few words. These range all the way from transient illusions, which may affect us inappreciably, to insanity in which our personality is submerged and lost. The term "dissociation" is nowadays employed to cover practically all mental abnormalities; and in so far as it tends to emphasise the fact that normally all mind activity is one of organisation and systematisation, it is a felicitous term. Such dissociations may be primarily sensory (anæsthesias), or ideational (hallucinations, delusions), or motor (automatisms). The phenomena of multiple personality, often known as alternating personality, are among the most interesting of these dissociations.

A. Multiple Personality.—In the "successive" form of this disorder a person may suddenly lose his memory of his past life, forget his name, his home, and his friends, and start afresh with a new name, a new occupation, etc. Often his temperament and character change simultaneously with this loss of memory. Whereas originally he may have been honest, cheerful, and vigorous, he now shows himself unreliable, pessimistic, and lazy. A few weeks or months later he suddenly reverts to his former personality and recovers all his memories of his earlier life, although he has no vestige of recollection as to the events which occurred during the period of his altered selfhood. Cases are on record where several characters have been assumed in this way, one after the other.

In the case of "simultaneous" personalities we have a more complex and much more ambiguous condition. Here there seems to be in addition to the normal consciousness which superintends the ordinary business of life, a sort of "split-off" consciousness, which is independent of the first and can be gotten at only in indirect ways. Moreover, as in the case of *successive* personalities, the temperament and character of these two selves are often very different. The one may be gentle and pious, the other riotous and profane. Sometimes this secondary self can be tapped by whispering to the patient while he is engaged in conversation with some one else, and then the responses may be written, apparently without any cognisance on the part of the normal consciousness of what has taken place. The memories of the two selves seem to be often distinct. Sometimes, as in alternating personality of the successive type, the secondary self may know all about the primary self, without the converse appearing to be true.

These quaint modifications of self-consciousness are difficult to reconcile with many of our prepossessions as to personality and the connection of mind and body. But they at least serve one purpose of positive value. They contain an impressive warning against our natural disposition to assume that our own personal type of self-consciousness is necessarily the only type. It should be remembered, too, that normal life contains occasional suggestions of the ease with which certain dissociative reactions may be set up. Many a man displays in the bosom of his family a self totally different from that known to his business associates, and each is consistently maintained. Evidently the consciousness of self is susceptible of mutations like other forms of consciousness, and no generalisation about it should be accepted without a survey of *all* the facts. For instance, the disintegrations of personality which are met with in the various forms of insanity must be taken into account.

B. Mediumistic Trance and Hypnosis.—Less profound and less prolonged than the disturbances already mentioned are the changes in personality which characterise certain forms of trance. In the genuine cases of so-called mediumistic trance the medium becomes more or less oblivious to ordinary sense impressions, and often appears to be half unconscious. Under these circumstances he assumes the personality of some other individual, usually some one who is dead, and his utterances purport to be expressions of the knowledge and the sentiments of the "control," as the person is called who ostensibly speaks through the medium. Many of these cases of mediumship have been carefully examined. Most of them have proved fraudulent. A few appear to be perfectly genuine, so far as concerns the psycho-physiological conditions manifested. But the *interpretation* of the phenomena is a matter upon which there exists the widest divergence of expert opinion. Most scientifically trained psychologists refuse to give these cases any serious consideration, beyond admitting the possibility of their presenting a genuine abnormality like insanity. A few insist that we have here fairly convincing evidence of relations among minds which transcend all our usual modes of communication with one another.

In hypnotism, also, we may meet with cases of altered personality produced under the influence of suggestion. Hypnotic sleep may be induced by "talking sleep," *i. e.,* telling the subject how it feels to fall asleep, by stroking the forehead and head, by fixating a bright object held above the level of the eyes, and in general by any device which will focus attention firmly on the directions given by the operator. Those methods are best which, like the first mentioned, occasion least strain. Sometimes one method will succeed when the others fail.

Changes in sensitivity (whether anæsthesias or hyperæsthesias), in motor control, and memory are not especially difficult to produce under hypnosis. The phlegmatic person may become choleric, the reserved person become flippant and rude, the irreligious become pious, etc. Commonly, if the hypnotic sleep has been deep, there is, upon awakening, little or no memory of what has occurred during the trance. But all the facts can usually be recalled during a subsequent hypnotisation. A curious phenomenon is that of post-hypnotic suggestion. A person told to perform some action after awakening may have no recollection of the injunction upon arousing from the hypnotic slumber, but with few exceptions he will at the time designated faithfully execute the act. Facts of this kind have led to a good deal of needless alarm as to the dangers of hypnotism. In point of fact it is practically impossible to force a person to do anything seriously offensive to his moral or æsthetic sense of the right and the decent. Moreover, persons of normal make-up can not be hypnotised against their wills—at all events not until the process has been performed so often as to become more or less habitual. A thing much more to be feared in our day is the auto-suggestion of a hypnotic character by virtue of which mobs and great crowds give way to the wildest and most beastly excesses, as often occurs in lynchings. Although hypnotism undoubtedly has therapeutic value, it should not be indiscriminately cultivated by untrained persons. The same statement holds true only in less degree of "suggestion" used as a medical method without actual hypnotising. Of its value there can be no question, for it has been demonstrated repeatedly from the dawn of time to the present day, and every successful general practitioner inevitably makes more or less use of it. But it must be intelligently employed, otherwise it may prove harmful.

C. Dreams and Sleep.—Dreams afford a familiar instance of disturbed personality. Sometimes this is manifested simply in the ridiculous judgments which we pass upon dream situations, and the absurd sentiments which they call forth.

Occasionally, however, we actually seem to have become some other person. Despite the frequent occurrence of dreams, no wholly satisfactory theory of their causes and conditions is yet at hand. Undoubtedly sensory stimulations, partly from the external senses, partly from the viscera and other intra-organic sources, are largely responsible for the beginning of dreams. Undoubtedly, also, the higher forms of systematised control, the "apperceptive activities" of many authors, are temporarily in abeyance. Although most of us would maintain that we often have dreamless sleep, it has been vigorously urged that we dream all the time during sleep, and that consciousness is consequently never altogether interrupted. Certainly it is true that we frequently forget our dreams with marvellous rapidity, and we ordinarily find that we are dreaming when awakened. But while these considerations afford a measure of presumptive evidence in favour of the hypothesis, they are not conclusive, and the weight of opinion unquestionably regards dreamless sleep as a frequent occurrence.

Sleep itself is a most interesting condition about which we are still strangely ignorant. We know that normally sleep is deepest, as judged by the intensity of sound which will awaken one, during the first hour or two, the maximum being reached rapidly. After that there is a rapid decrease and then for the four or five hours ordinarily preceding awaking it remains practically stationary. We know that during sleep the anabolic nutritive processes of the body are very active. It is a period of real repair of wastage. We know that we must have a certain amount of it regularly, if we are to enjoy normal effectiveness over a normal period of life. We know that nerve cells undergo exhaustion of their protoplasm during exercise and presumably this deficiency is restored during sleep. We know that there is normally less blood in the brain during sleep than at other times. But we know that certain of the nervous centres are independent of the necessity of sleep as commonly understood, *i. e.*, respiratory centres. Certain other physiological facts are known, but the exact mechanism of sleep is still a matter of doubt and research.

The Subconscious and the Unconscious.—Many striking and characteristic experiences are connected with regions of our personality which lie distinctly below the level of clear consciousness. Consciousness does not terminate with sharp edges which mark it off definitely and finally from the non-conscious. On the contrary, as was maintained early in our work, there is a gradual fading out from a focal centre of clearest consciousness toward a dimmer region of partial consciousness, which we may designate the zone of the *subconscious*. This subconscious area again gives way to a region of entire non-consciousness.

To the activity of the subconscious we are probably indebted for many of our unreasoned impressions and sentiments, for many of our unexpected ideas, for certain of our unreflective movements, especially those of the habitual variety. Not a few of our personal preferences and prejudices are probably referable to influences originating here. Such phenomena as those of automatic writing with the planchette, where persons may write considerable numbers of words without any clear idea of what is being written, belong to the border-line of influences lying between the subconscious and the unconscious. Taken all in all, subconscious factors must go to make up a very respectable portion of our total personality, and no doubt are accountable for many of the characteristics which sometimes cause us to wonder at ourselves and question whether or no we really have the kind of character we supposed.

There are many alleged facts in the realm of telepathy, clairvoyance and mediumistic trance which have led psychologists of repute to hold that our conscious minds are subconsciously in touch with psychic influences belonging to a far wider order than common sense ever suspects. This is hardly the "scientifically" accepted view. Indeed, the rank and file of experimentalists at least would probably reject all evidence emanating from such sources as presumptively insusceptible of scientific treatment and therefore as irrelevant to the science of psychology. Nevertheless, it must be admitted that of late years much serious effort has been devoted to applying experimental methods in this field and it may be that full success will finally attend these attempts.

The *unconscious* has been made in recent years the great panacea for all psychological and philosophical difficulties. Whatever one cannot explain otherwise may be explained by the action of the unconscious. The asserted facts of telepathy, clairvoyance, crystal-gazing, shell-hearing, hypnotism, and all the phenomena of spiritualism, not less than the metaphysical perplexities of personality, mind, matter, and their interrelations, have been treated by the universal elixir of the unconscious. Needless to say, our modest business at this point is with no such majestic influence as all this suggests. The term unconscious has two proper uses in psychology. It is, first, a limiting concept set over against consciousness of every kind; whatever is not conscious is unconscious. Evidently this use of the term is largely negative in its implication. As a positive concept the unconscious is, in the second place, practically synonymous with the physiological. Thus, to say that an unconscious factor entered in to determine certain of the movements of our voluntary muscles is simply to affirm that certain *neural* activities, whose obvious counterparts we cannot detect in consciousness, have contributed to the total mass of motor excitations. In this sense the unconscious ceases to be a sheer enigma, and becomes a more or less convenient term wherewith to designate those marginal neural actions which evidently modify the reactions we make, without, however, producing noticeable mental changes.

Summary.—If we take stock of the various points which we have canvassed in this chapter, we see that although the self undoubtedly manifests tendencies toward the systematic unification of its own experiences, it is far from being a simple unity. It is highly complex in constitution, and in many particulars highly unstable. It is distinctly and characteristically a life phenomenon, with periods of growth and expansion, periods of maturity, and periods of decay and disintegration. But after all, the consciousness of selfhood is the very core of our psychical being. About it are gathered all the joys and all the miseries of life. However much a critical philosophy may shake our confidence in its implication, the fact of its existence is for each of us the one absolutely indubitable fact.

COLLATERAL READINGS FOR STUDENTS.

The literature cited under section I is in the case of each chapter of an elementary character and it is intended to introduce the beginning student to materials and points of view somewhat different from those presented in this text. The references under section II are mainly to works of a more exhaustive character.

No attempt is made to add to the list of general bibliographies, of which a number are already available. Students desiring to work intensively upon some special subject should consult the topical bibliographies published annually in the Psychological Index, issued by *The Psychological Review.*

The titles below refer only to books in English. Advanced work, however, requires the constant use of the modern languages, especially French and German. The reports of many of the best investigations appear in these languages, which should consequently be mastered at once by students planning to specialize in psychology.

Chapter I, Problems and Methods of Psychology.

I. Wundt, Outlines of Psychology, Introduction, Sections 1-4.
Royce, Outlines of Psychology, Chapter I.
Calkins, Introduction to Psychology, Chapter I.
Sully, the Human Mind, Vol. I, Chapter II.

II. James, Principles of Psychology, Vol. I, Chapters I, VI, VII.
Ladd, Psychology, Descriptive and Explanatory, Chapters I, II.
Stout, Manual of Psychology, Chapters I and II.
Analytic Psychology, Vol. I, Chapter I.

Chapter II, The Psychophysical Organism and the Nervous System.

I. James, Psychology, Briefer Course, Chapters VII-IX.
Judd, Psychology, Chapters II and III.
Thorndike, Elements of Psychology, Chapters IX-XI.

II. Wundt, Principles of Physiological Psychology, Vol. I, Part I.*
Howell, Text-Book of Physiology, Chapters VI-XIII.
Loeb, Physiology of the Brain.
Donaldson, Growth of the Brain.
Whitaker, Anatomy of the Brain and Spinal Cord.

*The remaining parts of the translation of this great work have not yet appeared, but may be expected shortly and should be consulted on practically all the points treated in this text.

Chapter III, Mind, Neural Action and Habit.

I. James, Psychology, Briefer Course, Chapter X.
Royce, Outlines of Psychology, Chapters III and VIII.
Morgan, Introduction to Comparative Psychology, Chapter XI.

II. Baldwin, Mental Development, Methods and Processes (Third Edition), Part II, Chapters VII-IX.

Chapter IV, Attention, Association and Discrimination.

I. Attention:
Titchener, Outlines of Psychology, Chapter VI.
Wundt, Outlines of Psychology, Part III, Section 15.
Sully, The Human Mind, Vol. I, Chapter VI.
Calkins, Introduction to Psychology, Appendix VI.

Discrimination:
James, Psychology, Briefer Course, Chapter XV.
Royce, Outlines of Psychology, Chapter XI.

For references to association see Chapter VIII.

II. Ribot, Psychology of Attention.
Ladd, Psychology, Descriptive and Explanatory, Chapter V.
Stout, Analytic Psychology, Vol. I, Division II, Chapters II and III.

Chapter V, Sensation.

I. Titchener, Outlines of Psychology, Chapters II-IV.
Calkins, Introduction to Psychology, Chapters II-VIII; Appendix, Sections 3-5.
McKendrick & Snodgrass, Physiology of the Senses.

II. James, Principles of Psychology, Vol. II, Chapter XVII.
Stout, Manual of Psychology, Book II.
Ladd, Psychology, Descriptive and Explanatory, Chapters VI-VIII.

Chapter VI, Perception.

I. See references under Chapter VII.

II. Stout, Manual of Psychology, Book III, Division II, Chapter I.
Ladd, Psychology, Descriptive and Explanatory, Chapters XV-XVI.

Chapter VII, Perception of Spatial and Temporal Relations.

I. Titchener, Outlines of Psychology, Part III, Chapter VII.
Sully, The Human Mind, Vol. I, Chapter VIII.
Wundt, Outlines of Psychology, Part II, Sections 10 and 11.
Judd, Psychology, Pages 131-171.
James, Psychology, Briefer Course, Chapter XXI.

II. James, Principles of Psychology, Vol. II, Chapter XX.
Stout, Manual of Psychology, Book III, Division II.
Ladd, Psychology, Descriptive and Explanatory, Chapters VIII and XXI.

Chapter VIII, Imagination.

I. Titchener, Outlines of Psychology, Chapter VIII.
Wundt, Outlines of Psychology, Part III, Sectons 16-A, B, D, 13.
Baldwin, Senses and Intellect, Chapter XI.
Royce, Outlines of Psychology, Chapter VIII.
Calkins, Introduction to Psychology, Chapter XV.

II. James, Principles of Psychology, Vol. I, Chapter XIV.
Ladd, Psychology, Descriptive and Explanatory, Chapter XIII.
Stout, Manual of Psychology, Book IV, Chapter II.

Chapter IX, Memory.

I. Titchener, Outlines of Psychology, Chapter XI.
Wundt, Outlines of Psychology, Part III, Section 16-D, b.
Baldwin, Senses and Intellect, Chapter IX.

II. James, Principles of Psychology, Vol. I, Chapter XVI.
Ladd, Psychology, Descriptive and Explanatory, Chapter XVII.
Ribot, Diseases of Memory.

Chapter X, Consciousness of Meaning and the Formation of Concepts.

I. Sully, The Human Mind, Vol. I, Chapter XI.
Dewey, Psychology, Part I, Chapter VIII, Section 12.
Calkins, Introduction to Psychology, Chapter XVII.
Titchener, Outlines of Psychology, Chapter XII, Section 83.
Judd, Psychology, Chapter X.

II. Stout, Analytic Psychology, Vol. II, Chapter IX; Manual of Psychology, Book IV, Chapter IV and V.
James, Principles of Psychology, Vol. I, Chapter XIII.
Ladd, Psychology, Descriptive and Explanatory, Chapter XIX.

Chapters XI and XII, Judgment and Reasoning.

I. Baldwin, Senses and Intellect, Chapters XIV-XV.
Dewey, Psychology, Part I, Chapter VIII, Sections 3-5.
Royce, Outlines of Psychology, Chapter XII.
Calkins, Introduction to Psychology, Chapter XVIII.

II. James, Principles of Psychology, Chapter XXII.
Ladd, Psychology, Descriptive and Explanatory, Chapter XX.
Morgan Introduction to Comparative Psychology, Chapter XIII-XVI.

Chapters XIII and XIV, Feeling and Affective Consciousness.

I. Titchener, Outlines of Psychology, Chapters V and IX.
Wundt, Outlines of Psychology, Part I, Section 7; Part II, Section 12.
Royce, Outlines of Psychology, Chapter VII.
Calkins, Introduction to Psychology, Chapters IX and X.
Sully, The Human Mind, Vol. II, Appendix I.

II. Marshall, Pain, Pleasure and Æsthetics.
Stanley, Evolution of Feeling.

Dewey, Psychology, Part II.
Stout, Manual of Psychology, Book II, Chapter VII; Book III, Chapter III; Book IV, Chapter IX.
Analytic Psychology, Vol. II, Chapter XII.

CHAPTERS XV, XVI, AND XVII, REFLEX ACTION, IMPULSE AND INSTINCT.

I. James, Psychology, Briefer Course, Chapter XXV.
Royce, Outlines of Psychology, Chapter XIII.
Morgan, Introduction to Comparative Psychology, Chapter XII.

II. Baldwin, Development and Evolution, Part II, Chapters IV-VI.
Morgan, Animal Life and Intelligence, Chapter XI.
James, Principles of Psychology, Vol. II, Chapter XXIV.
Ladd, Psychology, Descriptive and Explanatory, Chapter XXV.

CHAPTERS XVIII AND XIX, EMOTION.

I. James, Psychology, Briefer Course, Chapter XXIV.
Royce, Outlines of Psychology, Chapter XIV.
Titchener, Outlines of Psychology, Chapters IX and XIII.
Calkins, Introduction to Psychology, Chapter XX.
Stout, Groundwork of Psychology, Chapters XV-XVII.

II. Ribot, Psychology of the Emotions.
Bain, Emotions and Will, Section on Emotions.
Stout, Manual of Psychology, Book III, Chapter IV.
Ladd, Psychology, Descriptive and Explanatory, Chapters XXIII and XXIV.

CHAPTERS XX, XXI, XXII, VOLITION, INTEREST AND DESIRE.

I. James, Psychology, Briefer Course, Chapter XXVI.
Höffding, Psychology, Chapter VII.
Royce, Outlines of Psychology, Chapter XV.
Titchener, Outlines of Psychology, Chapters VI and XIV.
Sully, The Human Mind, Vol. II, Chapters XVII-XVIII.

II. James, Principles of Psychology, Vol. II, Chapter XXVI.
Ladd, Psychology, Descriptive and Explanatory, Chapter XXVI.
Bain, Emotions and Will, Section on Will.
Dewey, Psychology, Part III.

CHAPTER XXIII, SELF AND THE ABNORMALITIES OF CONSCIOUSNESS.

I. James, Psychology, Briefer Course, Chapters XI and XII.
Calkins, Introduction to Psychology, Chapters XXII, XXIII, XXVII.
Sully, The Human Mind, Vol. II, Chapter XIX.
Jastrow, Fact and Fable in Psychology.

II. James, Principles of Psychology, Vol. I, Chapters IX and X.
Baldwin, Mental Development, Social and Ethical Interpretations.
Cooley, Human Nature and the Social Order.
Moll, Hypnotism.
Binet, Alterations of Personality.
Prince, The Dissociation of a Personality.
Jastrow, The Subconscious.

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