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# ELEMENTS OF PSYCHOLOGY

BY

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# PREFACE TO THE FIRST EDITION.

This book is designed to serve as a text for students who are pursuing a first course in psychology. It aims to present in an elementary way, and within a small compass, the more easily observed facts of our mental life together with the generally accepted principles of their explanation. Its field is chiefly the study of the normal, adult, human mind, and so may be described as an introduction to what is known as General Psychology.

In these days, 'the winter of our discontent,' the writer of a first book in psychology may follow one of three courses: he may appear as 'the champion of the structural psychology' or as the advocate of a psychology in terms of behavior or he may proceed after the manner of the eclectic, without special regard to the systematic agreement of the topics and matter selected. In the preparation of the present text, the writer followed the third course, and a word of explanation seems in place.

It is clear that many of the topics that belong to an introductory survey of psychology lend themselves easily and naturally to the functional method of treatment, while certain other topics, no less important in a first book, invite rather a structural treatment. It is clear, moreover, that the student may get important side lights from the biological, physiological, genetic and other points of view.

With these facts in mind, the author has disregarded systematic aims and has incorporated materials gathered from various points of view. He will admit, however, that such a course is not without its qualms; and he will not be surprised if the compounding of materials gathered from various sources, together with the shifts in respect to psychological doctrine involved thereby, should prove disturbing to those psychologists to whom system, consistency, and completeness are both inspiration and guide. At the same time, it is the writer's present belief that in a first course in psychology the student should be permitted to follow the easier, the more natural ways of approach; and that the sharp delimitation of points of view, consistency, and systematization belong rather to his later psychological achievements.

A word of explanation of the relative length of the chapter on "Consciousness and the Nervous System," and of the preponderance of anatomical over physiological matter therein may be required. Psychologists are agreed that the successful pursuit of their science presupposes at least an elementary knowledge of the structure and functions of the nervous system; but they differ in respect to who should supply this knowledge. Some of them insist that the psychologist 'needs all of the time at his disposal for his own science,' that it is the business of the physiologist to teach neurology. Certain others, while freely granting the theoretical soundness of this contention, and while freely admitting that under ideal conditions the teacher of psychology could make a course in neurology a prerequisite to his own courses, point out, on the other hand, that under the present organization of secondary and college education the vast majority of college and normal school students — probably seventy-five per cent on the average—come to psychology with little or no knowledge of the nervous system, and that the teacher of psychology must either supply at least a working basis of neurology, or he must exclude from his classes students who lack it. Most psychologists choose the former course.

In view of these facts it seemed to the author pedagogically desirable to include a brief description of the structure and function of the nervous system; further, that this description should begin with gross anatomy, and that the limits of the description of finer anatomy and physiology should be determined by the requirements of the later discussions of the text. This, at any rate, was the working plan of the chapter under review; and, in the author's experience in teaching introductory courses in psychology, the plan works well. The author hopes that teachers who elect to use this text and who desire to extend the scope and to vary the direction of their physiological and histological teaching, may find in the form and matter of the chapter a satisfactory basis therefor.

It is a pleasure to acknowledge the help I have received in the preparation of the book. My greatest indebtedness, as is evident in nearly every chapter, is to the writings of James and Titchener. But I have also drawn freely upon the writings of many

other authors, and I gratefully acknowledge the help received from them.

My colleague, Professor A. E. Davies, has given generously of his time to the discussion of the various topics of the text and to the careful revision of the manuscript and proofs. I am greatly indebted to him for his personal help and friendly criticism.

I am also under obligation to my colleagues, Professors T. H. Haines, G. F. Arps, J. A. Leighton, and A. P. Weiss, Instructor in psychology, for their criticisms of certain portions of the manuscript, and to Mr. Weiss for help with the proofs.

My best thanks are due also to Mr. Otto Giesen, M. A., for drawing a large number of the figures of the text.

Acknowledgments are due to the following authors and publishers for permission to use illustrations from their works: Professor E. B. Titchener and The Macmillan Company, publishers of his "Text-Book of Psychology"; Professor C. H. Judd and Charles Scribner's Sons, publishers of his "Psychology"; Professor H. H. Donaldson and Professor W. H. Howell, and W. B. Saunders and Company, publishers of "The American Text-Book of Physiology" and "A Text-Book of Physiology"; P. Blakiston's Son and Company, publishers of Morris's "Human Anatomy".

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## PREFACE TO THE SECOND EDITION.

In the revision of this text, many paragraphs and sections have been rewritten, a number of new paragraphs have been added, two new figures have been introduced, and the topics in several of the chapters have been rearranged. I hope that these changes mark an improvement, especially in respect to clearness and accuracy of statement, and in the serviceableness of the book as a teaching instrument.

It is a pleasure to acknowledge the debt of gratitude I owe to my friend and colleague, Professor A. E. Davies, for his never-failing help and counsel in the preparation of the revised text. I am also indebted to Professor T. L. Bolton of the University of Montana, and to Professor O. D. Humphrey of the New York Training School for Teachers, Jamaica, N. Y., for valuable suggestions and criticisms. I am also indebted to Professor Humphrey for securing the permission of Professor B. G. Wilder, of Cornell University, to use figure 4778, of his article in volume VIII, of "A Reference Handbook of the Medical Sciences."

My thanks are due to my pupils, Miss E. E. Courtney and Miss P. C. Salsberry, for help in correcting the proofs; and to my former pupil, Mr. Otto Giesen, for drawing figure 5.

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## CONTENTS.

PAGE

CHAPTER I. INTRODUCTION . . . . . . . . . . . 1

Psychology Defined.
Terminology.
Typical Divisions of the Field of Psychology
The Methods of Psychology.
Points of View in Psychology.
The Subject Matter of an Introductory Course in Psychology.
References.

CHAPTER II. CONSCIOUSNESS AND THE NERVOUS SYSTEM 14

General View of the Nervous System.
The Brain.
The Medulla.
The Pons.
The Cerebral Peduncles.
The Cerebellum.
The Cerebrum.
The Cerebral Convolutions and Fissures.
The Cerebral Lobes and Interlobar Fissures.
The Cerebral Cortex.
The White Matter of the Cerebrum.
The Three Types of Cortical Areas.
Localization of the Cerebral Functions.
The Spinal Cord.
Functions of the Spinal Cord.
The Peripheral Nervous System.
The Cerebro-Spinal Nerves.
The Cranial Nerves.
The Spinal Nerves.
The Sympathetic Nervous System.

PAGE

The Neurone.
The Chief Groups of Neurones.
Sensory Neurones and Sense Organs.
Free Sensory Endings.
The Encapsulated Sensory Endings.
The Special Sense-Organs.
Organs of Taste.
Organ of Smell.
Termination of Auditory Nerve-Fibres.
Termination of Optic Nerve-Fibres
The Motor Neurones and Motor Organs.
The Associative Neurones.
References.

CHAPTER III. SENSATION IN GENERAL . . . . . . . 68
Definition.
Sensations as Mental Elements.
Sensation and Sensory Stimulus
Sensation and Knowledge of the outside World.
Sensations as the Earliest Forms of Consciousness.
Pure Sensation.
Differentiation of Sensory Qualities.
The Attributes of Sensations.
The Classification of Sensations.
References.

CHAPTER IV. CLASSES OF SENSATIONS . . . . . . 82
Visual Sensations.
Classes of Visual Sensations.
The Color Pyramid.
Color Mixture.
Visual After-Images.
Color-Blindness.
The Color Zones of the Retina.

PAGE

Auditory Sensations.
Nature of the Stimulus.
Classes of Auditory Sensations.
The Attributes of Tones.
Classes of Tones.
Sensations of Smell.
Organ of Smell.
Olfactory Stimulus.
The Relations of Olfactory Sensations.
Cassification of Olfactory Sensations.
Sensations of Taste.
Organs of Taste.
Classes and Relations of Taste Sensations.
Cutaneous Sensations.
Sensations of Pressure.
Sensations of Temperature.
Sensation of Pain.
The Kinaesthetic Senses.
'Touch Blends.'
Organic Sensations.
References.

CHAPTER V. PERCEPTION . . . . . . . . . . . 116

Perception Defined.
Perception and Sensation Compared.
The Genesis of Perception.
Variations in Perceptional Stimuli.
Variations in Perceptions of Particular Things.
Illusions of Perception.
Classes of Illusions.
Equivocal Figures.
Hallucinations.
References.

PAGE

CHAPTER VI. MENTAL IMAGES . . . . . . . . . . 137

Percept and Image Compared.
Image and Idea Compared.
Type Images.
Class Images.
Individual Differences in Mental Imagery.
Types of Mental Imagery.
Symbol Imagery.
Kinds of Verbal Imagery.
The Attributes of Characteristic Images Differ.
References.

CHAPTER VII. ATTENTION . . . . . . . . . . 161

The Nature of Attention.
The Conditions of Attention.
The Motor Concomitants of Attention.
The Sensory Concomitants of Attention.
The Degrees of Attention.
The Range of Attention.
The Forms of Attention.
The Popular View of Attention.
References.

CHAPTER VIII. ASSOCIATION . . . . . . . . . . 185

Associative Connections.
Variations among Associative Complexes.
Conditions Favorable to the Formation of Associative Complexes.
References.

CHAPTER IX. MEMORY . . . . . . . . . . . . 198

Definition.
The Conditions of Memory.
Retention.
The Process of Revival.
The Sequence of Imaginal and Ideational Processes.

PAGE

Spontaneous Revival.
Revival through Similarity.
Active and Passive recall Distinguished.
Memory and Imagery.
Individual Differences in Memory.
Cramming.
Prodigious Memories.
References.

CHAPTER X. IMAGINATION . . . . . . . . . . . 228

Types of Imaginative Activity.
The Limits of Imagination.
Passive and Active Imagination.
The Beginnings of Imagination.
Individual Differences in Imagination.
References.

CHAPTER XI. THOUGHT AND THE THOUGHT-PROCESSES . 241

The General Nature of Thinking.
The Thought Processes as Functions.
The Thought Processes.
Thought as Ideation.
Thought as Abstraction.
Thought as Judgment.
Judgment as Synthesis.
Judgment of Objective Relations.
Relation of Ideation and Judgment.
Judgment and Reasoning.
Reasoning.
Explicit Reasoning.
Reasoned Judgments and Reasoning Distinguished.
Implicit Reasoning.
Inductive and Deductive Reasoning Distinguished.
Thought's Vehicles.

PAGE

CHAPTER XII. THE THOUGHT PROCESSES (continued) . 269

Comparison: Conditions.
Discrimination.
Individual Differences in Discrimination.
Analysis as a Thought Process.
The Conditions of Analysis.
Generalization.
The Beginnings of Thought.
References.

CHAPTER XIII. THE FEELINGS . . . . . . . . 289

Meaning of the Term Feeling.
The Number of Kinds of Feeling.
The Mental Conditions of the Feelings.
The Neural Correlates of the Feelings.
Feeling and Habit.
Feeling and Association.
Transference of Feeling.
References.

CHAPTER XIV. EMOTION . . . . . . . . . 315

The Distinctive Mark of Emotion.
The Factors of Emotion.
The 'James-Lange Theory' of Emotion.
The Genesis of Emotional Reactions.
References.

CHAPTER XV. THE SENTIMENTS . . . . . . . . 333

Meaning of the Term Sentiment.
Sentiment and Emotion Compared.
The Intellectual Sentiments.
The Moral Sentiments.
The Aesthetic Sentiment.
References.

PAGE

CHAPTER XVI. CONSCIOUSNESS AND ACTION . . . . 351
Automatic Movements.
Reflex Actions.
Instinct and Instinctive Action: Definition.
Instinctive and Reflex Action Compared.
Instinctive and Volitional Action Compared.
Instinct and Habit.
Instinct and Emotion.
Characteristics of Instincts.
The Principal Instincts and their Classification.
Individualistic Instincts.
Parental or Racial Instincts.
Social Instincts.
Secondary Adaptive Instincts.
Derived Instincts.
Habit: Definition.
Conditions of Habit-Formation.
Habit and Instinct.
The Nature of Voluntary Action.
Deliberation.
Decision.
The Consciousness of Effort.
Conditions of Effort.
Internal Volitional Activity.
References.

Index of Names and Subjects . . . . . . . . . 405

Index of Figures . . . . . . . . . . . . 412

# ELEMENTS OF PSYCHOLOGY

## CHAPTER I

### INTRODUCTION

**Psychology Defined.**—Psychology, the science of consciousness, undertakes to describe and to explain such things as memories, imaginings, hopes, fears, feelings, desires, aversions, impulses, volitions, and the like.

**Terminology.**— Psychologists use a number of technical terms and expressions to designate the subject matter of their science, and it is well for the student of psychology to become acquainted with them early in his course.

The terms 'mind' and 'consciousness', in their broadest meaning, include all mental processes irrespective both of their nature and the conditions of their occurrence. 'Consciousness' is also used in a narrow sense to mean a single mental experience. Thus a memory, an image, an anger, a desire, a choice, a pain sensation, a feeling, may each be spoken of as a consciousness.

Expressions which mean the same thing as consciousness in the narrow sense, are formed by coupling either conscious, mental, or psychical, with either 'process', 'phenomenon', 'fact', 'experience', or 'state', as follows: conscious process, mental experience, psychical phenomenon, and so on. Other equivalents of 'consciousness' may be obtained by combining any one of the words—process, phenomenon, or fact—with either, 'of mental life', 'of consciousness', of psychical life', or 'of mental experience'. Thus we have the expressions—process of mental life, phenomenon of psychical life, fact of mental experience, and so on, used synonymously with 'consciousness' in its narrower meaning.

Which one of the terms just mentioned shall be used in a given case depends upon the writer's convenience, his desire for variety of expression, or his individual preference.

It may be added that the term 'psychosis' was proposed by the English scientist, Huxley, as a synonym for 'conscious process', and that it is in high favor with certain authors.

Typical Divisions of the Field of Psychology.— The province of psychology is so wide and the interests of psychologists are so varied that the entire field is now divided, for purposes of study, into a large number of smaller fields, or departments. There is, however, considerable diversity among the classifications and subdivisions that have been proposed. This diversity is due, no doubt, to the fact that no single principle of classification has been advanced which is broad enough to meet the requirements of psychologists who approach the problem from different points of view. Accordingly, current classifications reflect and are controlled by the special interests or points of view of the individual psychologists who make them.

The typical primary, or fundamental, divisions of the field of psychology are: (a) normal and abnormal, (b) human and animal, (c) social and individual psychology. The first division is based upon the fact that the conscious processes of the individual members of the various animal species, or of particular groups of organisms (such as a company of men or a herd of animals) are, as a rule, uniform in nature, in mode of activity, in manner of development, and in physical conditions. When a given mental process, or group of mental processes, conforms to this general uniformity, it is said to be normal; when it departs from it, abnormal. According to this principle of classification, certain psychologists divide the entire field of psychology into Normal and Abnormal Psychology.

Another group of psychologists are interested mainly in the differences between the mental life of human beings and that of the lower animals, and so, in their scheme of classification, make the division of psychology into Human and Animal the fundamental one.

A third class of students are interested most in the mental life of human and animal societies, in the influence of group life on the mental experiences of men and of animals, and in the contrast between the mental life of groups of individuals, e. g., in societies, crowds, mobs, flocks, herds, and the mental life of the individual members when they are relatively free from social influences. This group of interests gives rise to the two great divisions of Social, or Collective, and Individual Psychology.

We have noted three typical primary divisions of the field of psychology. The manner in which the field may be further subdivided is indicated by the following table, which is based upon Titchener's Classification:[1]

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[1] *A Text-Book of Psychology*, 1910, § 7; also p. 43 ff.

The divisions and sub-divisions given herein belong to what is known as 'pure' psychology in contrast with the field of 'applied' psychology, meaning by the latter the applications of the facts and laws of pure psychology to the practical problems of social control—education, medicine, business, legal procedure, politics—in short, to those arts which undertake to influence the actions of human beings.

- Psychology of the Normal Mind
  - Individual Psychology
    - Human Psychology
      - General—the psychology of the normal, adult, civilized, human mind.
      - Special
        - Psychology of infancy.
        - " of childhood.
        - " of adolescence.
        - " of senility.
      - Differential—the study of the differences between individual human minds.
    - Animal Psychology
      - General.
      - Differential
    - Comparative Psychology—the comparative study either of types of animal mind, or of these and the human mind at various stages of development.
  - Collective Psychology
    - Social Psychology—the study of the nature and products of the social mind.
    - Ethnic Psychology—the psychology of nations and races.
    - Class Psychology—the differential psychology of classes, professions, trades.
- Psychology of the Abnormal Mind
  - Individual Psychology
    - Psychology of deficient and exceptional minds, e. g., of idiots, deaf-mutes, the blind, geniuses.
    - Psychology of temporary mental abnormality, as in dreams, intoxication, fatigue, hypnosis, hallucinations.
    - Psychology of permanent mental derangement: the various forms of insanity.
  - Collective Psychology—the psychology of mobs, panics, fads, stampedes, emotional epidemics.

**The Methods of Psychology.** — Psychology employs two methods of studying consciousness; the direct and the indirect. By the direct method is meant the examination of our own mental experiences. Thus, when we compare our images of given colors, or the intensity of two sound sensations, when we examine carefully our motives for a given line of conduct, when we observe that we attend to one class of objects and not to another, we are studying consciousness by the direct method. By this method the student may answer, at least roughly, such questions as:

1. How do I know that the sound which I hear is the whistle of a locomotive?
2. How do I set about recalling a forgotten name?
3. How do my experiences of anger differ from my fears?
4. Why is it so easy for me to attend to some things and so difficult to attend to others?
5. Why does the sight of the letter A recall its name?
6. Can I see in my mind's eye my break-fast table? Are its various features distinct or indistinct, clear or dim, bright or dull?
7. What are my sense-experiences in a given five-minute period?

The indirect method is employed when we study consciousnesses through their signs or products. For example, we judge from certain signs or expressions that a man is angry, or frightened, or grieved; that a child wishes a given article or does not wish it; that one dog is friendly or hostile toward another; that a person is experiencing delusions of persecution; that a crowd of people have lost their wits;

and from the ceremonies, rituals and customs of peoples, savage and civilized, we infer that they have certain beliefs, fears, hopes, ideals and life purposes.

We cannot draw a sharp distinction between the signs of conscious processes and the products of those processes. But, speaking broadly, the term "mental production" means something which consciousnesses produce through their relation to the muscles of the body, particularly those of the hands and arms, and those of the organs of speech. For example, buildings of all kinds, dwellings, schoolhouses, business blocks, chapels, churches, temples are mental products in this sense, and so give us insight into the minds of their designers and builders. Works of art — music, painting, sculpture, poetry, oratory — institutions, customs, laws, languages, either of individuals or of groups of individuals, are mental creations and so are revelations, in some measure, of the nature of the mental life of their creators. The text-books the student is using, the lectures he is hearing from day to day, the chemical formulæ, the literary or historical interpretations, the scientific facts or laws and their applications, are mental products, and in so far as the student masters them and in so far as he is able to think of them as mental productions, he is gaining an insight into the nature of the mental activities of human beings.

It may be observed next that the field in which the direct method is employed is comparatively small, being limited to the study of the normal, human, civilized adult mind. The animal mind, the undeveloped mind, the collective mind, and, usually, the abnormal mind, are studied by the indirect method, i. e., by interpreting their signs and products.

Although the direct method of studying mental phenomena is relatively limited in the range of its application, it is the *primary* and the most important method of gaining knowledge concerning such phenomena. Since its results are more reliable than those obtained by the indirect method — we know our own mental life better than we can know that of others — and since we interpret the signs of the conscious processes of others by reference to our knowledge of the relationship between our own conscious states and their expression, the direct method is sometimes described as the psychological method *par excellence.* This fact, as we shall see in a later paragraph, has an important bearing upon the question of where, with what department, one's study of psychology should begin.

**Points of View in Psychology.** — The study of consciousness may be approached from any one of five points of view. According to one — the 'structural', as it is called — conscious processes are either mental elements, so-called, or are compounds of such elements. Accordingly, from this point of view, the psychologist undertakes to determine the exact number of the elementary mental processes, to describe and to explain them; he also undertakes the analysis of complex mental experiences, e. g., perceptions, memories, emotions, choices, in order to determine the number, character, and order of arrangement of their constituent parts.

But the enumeration, description, and explanation of the elementary mental processes and the analysis of complex mental states into their components is only one part of the undertaking from the structural point of view. It involves still further the description and the explanation of the ways in which given conscious elements combine so as to form complex conscious experiences, e. g., perceptions, imaginations, emotions, volitions, and so on. The aim in this case is to answer such questions as: What are the factors and what the conditions of their combination in one's perception of a given landscape, or in one's memory of a ball game? What elements combine and in what order and in what proportions to make up the emotions of fear or anger? The enumeration, description, and explanation of the elements of consciousness and the exposition of the laws of their combination thus constitute the two principal psychological problems from the structural point of view.

The term 'analysis', which plays so large a part in the literature of structural psychology, was borrowed very likely from chemistry. But it should be carefully noted that the chemist and psychologist do not use the term in precisely the same sense. The chemist actually analyzes many chemical compounds into their elements, so that each element exists apart and is studied as a thing by itself. The 'analysis' of the psychologist, on the other hand, is more like that of the student of elementary botany, who, without in the least disturbing the structure of the flower, observes that it is composed of sepals, petals, stamen, or pistil. The analysis which the psychologist makes of a mental experience is not a literal picking the experience to pieces; it is rather an enumeration of its several features, it is attending now to one part or aspect, now to another.

From the first point of view, interest centers in the structure or composition of consciousness, in the nature of the conscious elements, and the laws of their combination. From a second point of view, we may study mental functions or mental activities. In this case, the primary aim is (1) to enumerate, to describe and classify the various forms of mental activity; (2) to set forth the laws of their appearance; and (3) to give an account of their relations to one another. This point of view, when taken broadly, may include also an account of the part which mental processes play in the lives of individuals or in the activities of groups of individuals.

'Functional psychology', as this way of studying our mental life is usually called, undertakes to furnish answers to such questions as—how does memory differ from imagination? how do perceptions differ from images? why do we remember certain of the events of our past lives and forget others? why do the words, "the first President of the United States" suggest 'Washington'? why do some objects attract our attention while others are overlooked? how do we learn to spell, to repeat conjugations and to add columns of figures? how do such instincts as curiosity, pugnacity and manipulation affect their possessor's conduct?

In the third place, we may study mental phenomena from the genetic point of view. In this case we may study either the growth and development of the mental functions and capacities of individuals (human or animal) or we may be concerned with the larger problems of the evolution of mind in the human race or in the animal series. In the one case, an effort is made to trace the order of appearance of the various mental functions of the individual, e. g., seeing, hearing, recognizing, remembering, imagining, judging, willing, and so on, and to determine the facts and laws of their development. In the second case, we are concerned with the mental life of man and of the lower animals at different levels of development, and an effort is made to determine what mental functions and capacities appear at the different stages of biological evolution, in what order they make their appearance, and under what conditions. These various interests in the phenomena of the growth and the development of mental functions are grouped under the title — Genetic Psychology.

From a fourth point of view, we may inquire concerning the general utility of consciousness, the purposes which it serves in the individual life or in the life of the race; or more particularly, we may ask how a given mental experience helps or hinders its possessor in getting along in the world. For example, what is the biological value of seeing and hearing? what is the function of memory in adapting an organism to its environment? what purposes do the feelings of pleasantness and unpleasantness serve? or of what use, from the point of view of an individual's welfare, are his various emotional and instinctive responses? The science which treats of the purposes which consciousness serves in the struggle for existence is called Biological, or Teleological, Psychology.

In the fifth place, we may study consciousness from the point of view of the two closely related sciences of Psychophysics and Physiological Psychology. From the standpoint of the former, we inquire concerning the relationship between our mental experiences, especially our sensations, and the given physical processes with which they are correlated. From the point of view of Physiological Psychology, attention centers on the structure and functions of the sense-organs, and upon those parts and activities of the nervous system which subserve, in a special way, our mental life.

**Summary.** — Structural Psychology is the science of the structure of consciousness and conscious processes; Functional Psychology is the science of mental activities; Genetic Psychology concerns itself with the phenomena of mental development and evolution; Biological Psychology describes the uses which mental processes serve in adapting an organism or group of organisms to its environment. Psychophysics and Physiological Psychology study consciousness in relation to its physical and physiological conditions and concomitants.

**The Subject-matter of an Introductory Course in Psychology.** — A survey of the scope of psychology, even such as is made in the preceding pages, makes it clear that we cannot hope to cover the entire field in an introductory course; we must select some one department or aspect of the entire subject. It will be granted further that we should begin with those topics that are truly introductory and fundamental to our later psychological studies.

Perhaps, because of his practical interests or because of his interest in the strange and marvelous aspects of mental life, the student would prefer to begin at once with the practical and curious questions, as, for example: What makes us dream? What is hypnotism? How can one improve his memory? Do animals reason? What is the psychology of successful advertising? What causes delusions of grandeur in certain forms of insanity? and so on. Now these, and hundreds of kindred questions, are legitimate enough in their place, but their place, as experience has abundantly proved, is not in an introductory survey, except as they arise incidentally in the pursuit of the main business of such a course.

What, then, should be the nature of a first course in psychology? The answer which is usually given to this question is: a first course in psychology should be General Psychology; and by General Psychology is meant a study of the normal, adult human consciousness with reference: (1) to its structure, or internal constitution; (2) to its modes of activity; (3) to its physical conditions or concomitants. Incidental to these three ways of regarding its subject matter, an introductory course may properly include, so far as they have been scientifically determined, the facts and laws relative to the origin and development of mental functions and capacities in the individual and in the race, and also an account of the purposes or uses which mental processes serve in the general life activities of an organism or of a group of organisms.

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# CHAPTER II

## CONSCIOUSNESS AND THE NERVOUS SYSTEM

Everyday observation teaches that the course of our mental life bears a very close relationship to the bodily organism and the various processes which constitute its life. Thus, it is well known that our sense experiences — seeing, hearing, tasting, smelling, for example — depend upon the activities of certain sense organs; that feelings of pleasantness and unpleasantness are often connected with definite bodily changes; that the physiological effects of certain substances like alcohol, opium, tobacco, coffee and tea, are frequently accompanied by marked changes in consciousness; finally, that certain bodily diseases often produce characteristic changes in the mental life of the patient. Familiar observations of this character underlie the common belief that many of the phenomena of consciousness are dependent upon changes in the bodily organism. There are, on the other hand, many bodily changes which common opinion attributes to the influence of the mind. Thus the mind is supposed to be able to control freely the gross movements of the body, to cause it to move as a whole or to remain at rest, to move certain parts or to keep them quiet, to look or to turn away, to listen or to turn a deaf ear. Again, common observation seems to teach that the conscious processes known as emotions, e. g., fear, grief, anger, joy, cause conspicuous bodily disturbances, and that mental agitation or depression, as in the manias and melancholias, has a direct effect on the bodily processes, particularly those of respiration, circulation, and digestion.

This body of knowledge or belief concerning the relation of our mental life to its physical basis has been the common property of thinking men for a very long time, certainly from the time of the earliest Hebrew and Greek writers. It is, however, only in the recent centuries that an effort has been made to show in detail the nature of this connection, to clear up obscurities, to weed out superstition and error, and to ground theory on verified facts; and it is generally conceded that the results of this effort constitute one of the most notable achievements of modern scientific endeavor. It is, however, no part of our present undertaking to trace even in outline the history of opinion in reference to the relationship between the mind and the body. We shall come at once to the modern teaching on this subject, which is that our mental life is intimately related to, and dependent upon, changes in the nervous system. This doctrine is usually summed up in the law of psycho-neural correlation, namely, that every mental process is accompanied by a neural process, a change in the nervous system; or, to use a phrase coined by Huxley—every psychosis has its neurosis. This law, which is now supported by a mass of evidence so convincing that there is little likelihood that it will require revision in any important respect,

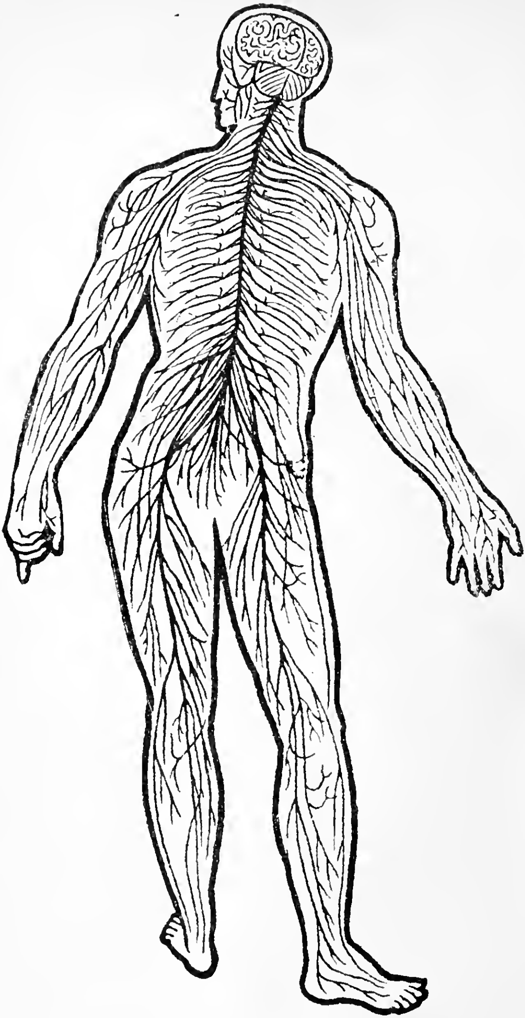

Fig. 1. Diagram showing the general arrangement of the human nervous system. (After Martin, modified.)

forms the chief stone of the corner of the modern theory of the physical basis of mental life.

**General View of the Nervous System.** — The remainder of this chapter will consist mainly of the study of a carefully selected series of figures and drawings illustrative of those features of the structure and function of the nervous system which are of interest in an introductory course in psychology. The chief purpose of the descriptive matter of the text is to aid the student in his examination and understanding of the figures.[1] The latter fall into three classes: (1) those intended to give a view of the general arrangement of the human nervous system and some idea of the gross anatomy of its principal parts; (2) a series of figures which relate to its minute anatomy, or finer structure; (3) a third series is intended to illustrate the simpler functions and activities of the nervous system.

Figure 1 gives some idea of the general arrangement of the principal parts of the nervous system, three features of which may be noted in the figure: (1) the brain enclosed within the cranium; (2) the spinal cord in the spinal column; (3) the large nerve trunks leading from the brain and spinal cord to all parts of the body. By the aid of the microscope the anatomist is enabled to follow the divisions of the nerves into smaller and smaller branches, even down to the nerve fibers of which the nerves are composed, and even to the bifurcations of the nerve fibers be-

[1] Note. In order to avoid confusing details the figures have been, in most cases, greatly simplified.

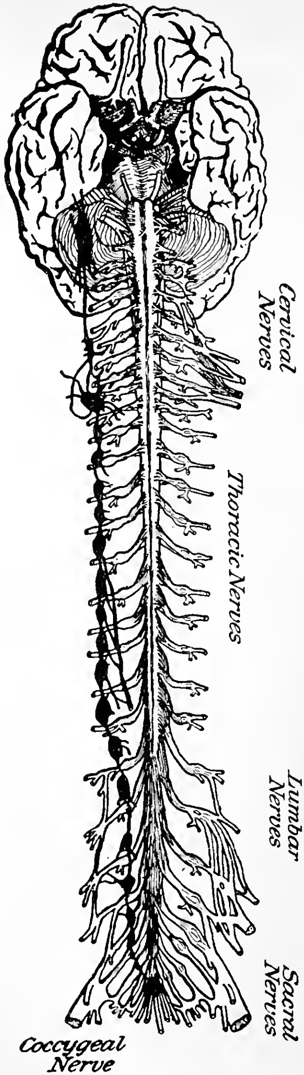


FIG. 2. Ventral aspect of the central nervous system. (After Morris.)

fore they terminate in the sense-organs, glands, muscles, tendons, and other structures. In reference to the intimacy of the connection of all the parts of the human nervous system and the extensiveness of its distribution, Hardesty writes: "Could all the other tissues of the body be dissolved away, still there would be left in gossamer its form and proportions — a phantom of the body composed entirely of nerves."

Anatomists usually refer to the nervous system as consisting of two main divisions: (1) The central nervous system (the cerebro-spinal axis), composed of (a) the brain, and (b) the spinal cord; (2) the peripheral nervous system, composed of (a) the cerebro-spinal nerves, and (b) the sympathetic nervous system. The student should remember, however, that this division is only for convenience in description, and that in fact all parts of the nervous system are intimately related functionally. Figure 2 shows (a) the central nervous system (brain and spinal cord); (b) portions of the cerebro-spinal nerves originating in the brain and spinal cord, and (c) one of the ganglionated cords of the sympathetic system attached (on the left side as one looks at the figure) to the spinal nerves. The brain is lifted up and backward from its usual horizontal position.

**The Brain.** — The brain is that part of the central nervous system which lies within the skull, or, more exactly, it is that portion of the cerebro-spinal axis which lies in front of or above the level of the first pair of spinal nerves. We have seen that the spinal cord and the parts composing the brain are structurally continuous. The line separating them is therefore chosen somewhat arbitrarily. Figure 3, a drawing of the brain as seen from below, is in-

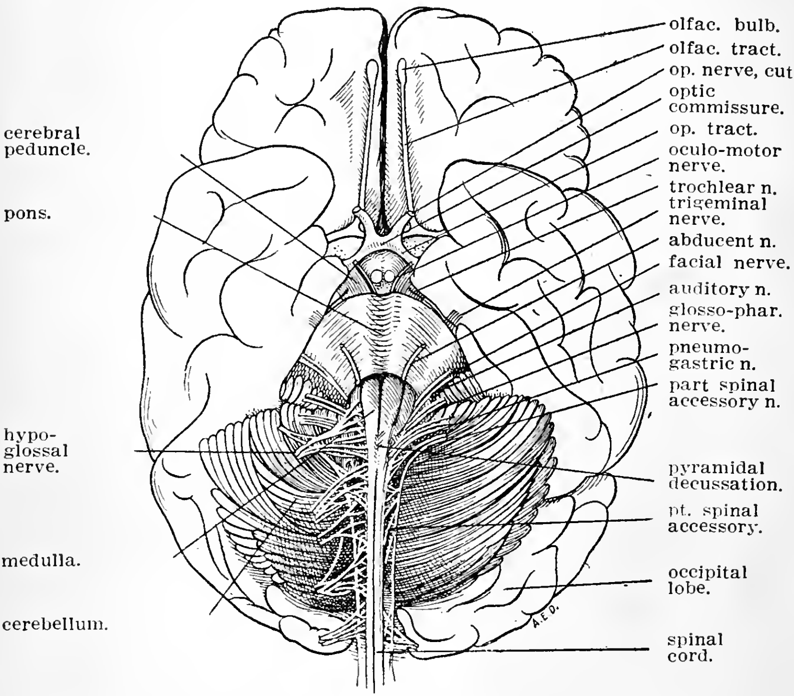


FIG. 3. Inferior aspect of Brain, showing superficial origins of all the cranial nerves except the trochlear.

tended to show the relative positions of the five parts composing it, namely, the medulla, the pons, the cerebral peduncles (crura cerebri), the cerebellum, and the cerebrum. The first three — the medulla, pons, and cerebral peduncles—together make up the brain-stem, which is primarily a great pathway between the cerebrum and cerebellum, and between these two parts and the spinal cord. The two latter, the cerebrum and the cerebellum, contain the centers correlated with sensation, motor excitation, and the higher mental processes. We may consider briefly the chief points of structure and function of each of the five divisions of the brain just named.

**The Medulla.** — Superficially regarded, the medulla appears to be a continuation of the spinal cord and extends from the foramen magnum, the opening at the base of the skull, to the lower margin of the pons above, a distance of about one inch. (See Fig. 3.) The medulla is of interest mainly because it is the center of control of the organs of circulation and respiration and because in it occurs the *decussation of pyramids* — strands of nerve fibers, whereby the principal motor fibers, in their passage from the cortex of the cerebral hemispheres to the spinal cord, suddenly cross to the opposite side of the medulla and enter the spinal cord on the opposite side from which they arose in the cerebrum.

**The Pons.** — The pons Varolii appears as a great prominence, quadrilateral in shape when viewed from in front, lying between the medulla below and the cerebral peduncles above, and between the two parts of the cerebellum, and is sometimes called the bridge of the brain. (See Fig. 3.) Its chief functions appear to be to connect the two parts of the cerebellum with each other, to connect the cerebellum with the brain-stem, and to form a pathway between the cerebellum and the cerebrum.

Cerebral Peduncles.— The cerebral peduncles, the principal divisions of the mid-brain, appear, when the brain is viewed from below, to consist of two thickish stalks which emerge from the upper border of the pons and pass each to one side and upward to enter the cerebral hemispheres. (See Fig. 3.) The peduncles consist of sensory and motor fibers running between the cortex of the cerebrum and the lower parts of the brain—the cerebellum and pons—and the spinal cord. Their chief function, accordingly, is to serve as a pathway between these parts of the central system.

The Cerebellum.— The cerebellum, or "little brain" or "hind brain," as it is sometimes called (Fig. 3), lies behind the pons and medulla and below the posterior portion of the cerebrum, from which it is separated by a thick layer of the *dura mater*, the tough, fibrous covering of the brain. The two hemispheres of the cerebellum are connected with the medulla, the pons, and the mid-brain, and so indirectly with the cerebrum and spinal cord by three bands of nerve fibers, known as the inferior, middle, and superior peduncles.

Physiologists are not agreed as to the function or functions of the cerebellum; but it is likely, according to Howell, that by virtue of a nervous mechanism which, on the afferent (sensory) side, is connected with the sensory nerves leading from the vestibule of the ear, the muscles, joints, and tendons, and which, on the efferent (motor) side, is in direct connection with the motor areas of the brain as well as the motor centers in the spinal cord, "the cerebellum is a central organ for co-ordination of voluntary movements, particularly the more complex movements necessary in equilibrium and locomotion."[1]

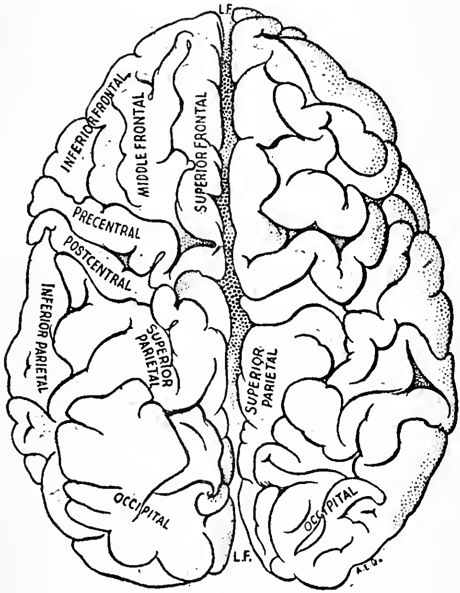


FIG. 4. Superior aspect of cerebral hemispheres. L. F., longitudinal fissure.

**The Cerebrum.** — The cerebrum, the largest and, psychologically, by far the most important part of the central nervous system, consists of the two cerebral hemispheres, which are connected at the base

[1] *A Text-Book of Physiology*, 1909, p. 237 f.

by a white band of nervous matter known as the corpus callosum, but are separated in front, on top, and at the rear by the deep longitudinal fissure. (L. F. Figure 4.)

The structural features of the cerebral hemispheres of most interest to psychology are: (1) the cerebral convolutions and fissures; (2) the cerebral lobes and interlobar fissures; (3) the outside layer of cell-bodies and cell processes, i. e., the nerve cells of the cerebral cortex; (4) the white central mass of the hemispheres composed of nerve fibers which connect the different parts of the cortex, and the cortex with other parts of the central nervous system. These structural features will be considered in the order named.

**The Cerebral Convolutions and Fissures.** — Superficially viewed, the most conspicuous feature of the surface of each hemisphere is its division into numerous folds or elevations — the cerebral convolutions, or gyri — and fissures, or sulci, which separate the convolutions from one another. A number of the more prominent convolutions of the lateral aspect of the left hemisphere are indicated on Fig. 5, p. 25. The figure also shows the location of the Sylvian and the Rolandic fissures.

**The Cerebral Lobes and Interlobar Fissures.** — For the purpose of description, brain anatomists divide the surface of each hemisphere into more or less definite areas known as *lobes*, the boundaries of the lobes being marked roughly by the more conspicuous cerebral fissures. The locations of the lobes and the interlobar fissures are indicated with sufficient exactness by the accompanying figures (3, 4, 5, 6), which give respectively the inferior and the superior aspects of the brain, and the lateral and mesial (inner) aspects of the left hemisphere.

*The interlobar fissures* are: (1) The Sylvian fissure, seen on the lateral side of the hemisphere (Fig. 5), and consisting of the stem, an anterior horizontal branch, an anterior ascending branch,

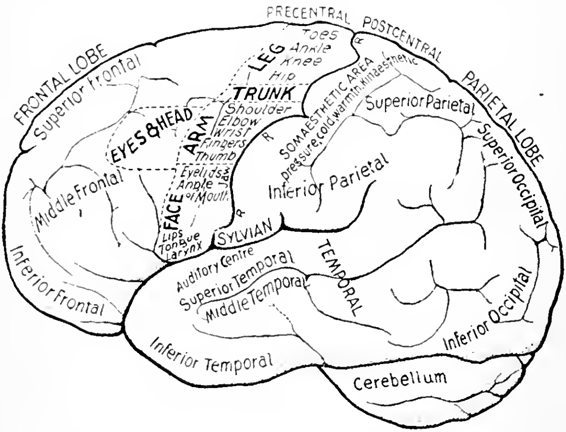


FIG. 5. Lateral view of left cerebral hemisphere. R. R. R. Rolandic fissure. (After Wilder, modified)

and the conspicuous posterior branch; (2) the Rolandic, or central fissure (R. R. R., Fig. 5), which begins slightly above and in front of the anterior end of the posterior branch of the Sylvian fissure, extends obliquely upward and slightly backward, and passes over the upper border of the hemisphere and downward for a short distance on its mesial surface. The Rolandic fissure forms a definite boundary on the lateral surface between the frontal and parietal lobes; (3) the parieto-occipital fissure (Fig. 6) belongs chiefly to the inner (mesial) surface of the hemispheres, and separates the mesial surfaces of the parietal and occipital lobes; (4) the collateral fissure (not represented in the accompanying figures) separates the mesial surface of the temporal lobe from the limbic lobe; (5) the calloso-

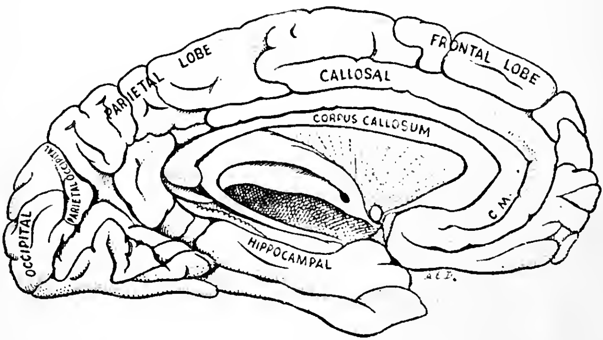


FIG. 6. Mesial aspect of left cerebral hemisphere. C. M. Calloso-marginal fissure.

marginal fissure (c. m. Fig. 6), a clearly marked sulcus on the mesial surface of the hemisphere, begins below the fore-end of the corpus callosum, sweeps upward and around the end of the callosum, arches backward following the curve of the callosum almost its entire length, then turns upward to the upper border of the mesial surface of the hemisphere; (6) the fissure of Reil, which partly separates the island of Reil from the frontal, parietal, and limbic lobes.

The *lobes* of the cerebrum are: (1) the frontal; (2) the parietal; (3) the temporal; (4) the occipital; (5) the limbic; (6) the insula (island of Reil.)

The frontal lobe is the largest of the six named, and includes about one-third of each hemisphere. The lateral surface boundaries of the frontal lobe are: (1) The Rolandic fissure at the rear (R. R. R., Fig. 5), which separates it from the parietal lobe, and (2) the anterior branch of the Sylvian fissure (Fig. 5), which divides it from the temporal lobe. On the mesial surface the vertical limb of the calloso-marginal fissure forms the rear boundary line of the frontal lobe (see Fig. 6). On the inferior surface of the hemisphere the frontal lobe is separated from the temporal lobe by the transverse stem of the Sylvian fissure.

The parietal lobe has two surfaces, a lateral and a mesial. The boundaries of the lateral surface are: (1) an imaginary line dividing the lateral and the mesial surfaces of the hemisphere; (2) the Rolandic fissure in front; (3) an imaginary line drawn from the point at which the parieto-occipital fissure passes from the mesial to the external surface of the hemisphere (see Fig. 6) to the preoccipital notch, near the posterior end of the Sylvian fissure; (4) the posterior branch of the Sylvian fissure, forming the lower boundary of the parietal lobe. The boundaries of the mesial surface of the parietal lobe are: the vertical limb of the calloso-marginal fissure in front, the calloso-marginal fissure below, the parieto-occipital fissure at the rear, and above, the upper edge of the mesial surface of the hemisphere.

The occipital lobe has three surfaces, a lateral, a mesial and an inferior, the locations of which are indicated roughly in Figs. 4, 5 and 6.

The temporal lobe is separated on the lateral surface of the hemisphere from the frontal lobe by the deep cleft or stem of the Sylvian fissure; from the parietal lobe by the posterior limb of the Sylvian fissure and an imaginary extension of the latter. (See Fig. 5.) On the mesial surface the collateral fissure divides the temporal and limbic lobes. The posterior boundary of the temporal lobe, the line separating it from the occipital lobe, is formed by the extension backward and mesialward of the imaginary line which separates the parietal and occipital lobes.

The limbic lobe (Fig. 6, p. 26) is on the mesial and inferior surfaces of the hemispheres, and includes two principal convolutions, or gyri, the callosal and the hippocampal. The former lies along the upper surface of the corpus callosum, curves downward round the rear end of the corpus callosum and narrows into a convolution called the isthmus. The hippocampal gyrus curves forward from the isthmus toward the apex of the temporal lobe.[1]

The insula, or island of Reil, is a triangular area of the cerebral cortex concealed within the Sylvian fissure by the over-hanging folds of the frontal, temporal and parietal lobes.

**The Cerebral Cortex.** — The cortex, the chief organ of consciousness, forms the outer layer of each of the cerebral hemispheres. It is grayish in appear-

[1] Piersol, *Human Anatomy*, vol. II, p. 1150 f.

ance, and averages about 3 mm. in thickness. Under the microscope, the cortex is seen to be composed of fairly well-marked layers of nerve-cells or "neurones," consisting of cell-bodies and nerve-fibers, together with the neuroglia, or supporting tissue.

**The cell-bodies.** — The accompanying figure (p. 30, Fig. 7) represents a section of the cortex, cut perpendicular to the surface of the convolution, showing the distribution of the cell-bodies of the neurones. The order of the layers, beginning with the outer one, is: (1) The stratum zonale; (2) the layer of small pyramidal cells; (3) the layer of large pyramidal cells; (4) the polymorphic cells.

The functions of the cell-bodies are: (1) to receive nerve impulses; (2) to distribute the impulses thus received to other parts of the brain.

The **nerve-fibers** of the cortex may be arranged into five groups: (1) The bundles of radial fibers composed of efferent (outgoing) and afferent (incoming) fibers, the former consisting largely of axones of the pyramidal and polymorphic cells; the latter, of fibers derived from cells located in regions of the brain remote from the cortical areas in which the fibers terminate; (2) the interradial felt-work of fibers, consisting chiefly of lateral and collateral cell processes, and occupying the spaces between the radial bundles; (3) the outer stripe of Baillarger containing a highly intricate layer of processes and collaterals from the large pyramidal cells; (4) the supra-radial felt-work of Edinger, a second layer of finely interlaced nerve processes and collaterals;

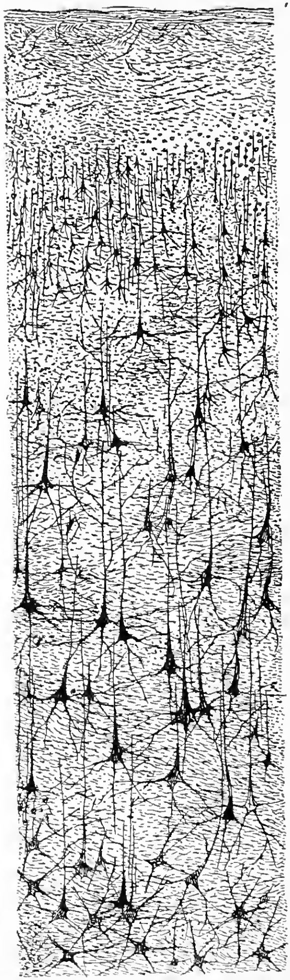


FIG. 7. Section through the cerebral cortex.

(5) the tangential fibers, a layer of innumerable delicate fibrils which run horizontally and parallel to the surface of the cortex. The layer of tangential fibers consists in part of the long processes and collaterals of the cells in the stratum zonale, but chiefly of the terminal branches of the dendritic processes of the pyramidal and polymorphic cells and the fine terminal filaments of fibers which spring from the lower brain regions.

**The White Matter of the Cerebrum.**— Just beneath the layer of polymorphic cells (Fig. 7) lies the white matter of the hemisphere. This consists of bundles of nerve fibers, their supporting tissues, and a small number of minute blood vessels. The fibers, classified according to the relation which they bear to the cortex, are: (1) The projection fibers; (2) the association fibers, and (3) the commissural fibers.

The *projection fibers* (A, B, C, D, and E, of the accompanying figure 8, p. 32) connect the cerebral cortex with the mid-brain, the pons, the medulla, and the spinal cord, and their function is to carry outgoing nerve impulses to these portions of the central nervous system (the mid-brain, pons, medulla, and spinal cord) and to carry incoming impulses from these organs — the pons, medulla and so on — to the cortex.

Perhaps it will aid the student in forming an idea of the arrangement of the bands of projection fibers to liken the hemisphere to the half of a goose-egg, flattened on the under side, to represent the inferior surface of the hemisphere. Further, we may liken the shell of the egg to the protecting parts of the cerebrum, the thin membrane just beneath the shell to the cerebral cortex, and the projection fibers to fine threads running from the various portions of the thin membrane to a point a little to the rear of the center of the lower border of the inner flat surface.

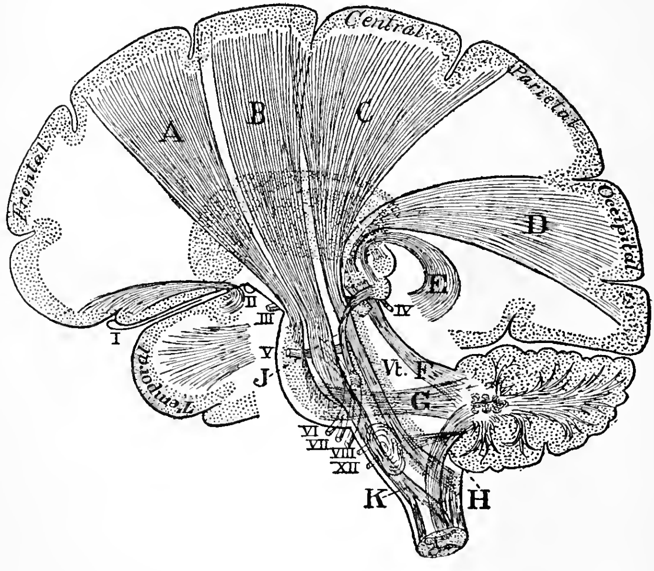


FIG. 8. Schema of the projection fibers of the cerebrum and of the peduncles of the cerebellum; lateral view of the internal capsule: *A*, Tract from the frontal gyri to the pons nuclei, and so to the cerebellum (frontal cerebro-cortico-pontal tract); *B*, the motor (pyramidal) tract; *C*, the sensory (lemniscus) tract; *D*, the visual tract; *E*, the auditory tract; *F*, the fibers of the superior peduncle of the cerebellum; *G*, fibers of the middle peduncle uniting with *A* in the pons; *H*, fibers of the inferior peduncle of the cerebellum; *J*, fibers between the auditory nucleus and the inferior colliculus; *K*, motor (pyramidal) decussation in the bulb; *Vt*, fourth ventricle. The numerals refer to the cranial nerves.—(Modified from *Starr* by *Howell.*)

The *association fibers* (Fig. 9) connect different parts of the cortical areas of the same hemisphere. They are classed as either short or long association bundles. The short bundles, marked A in the figure, curve around the bottoms of the fissures and con-

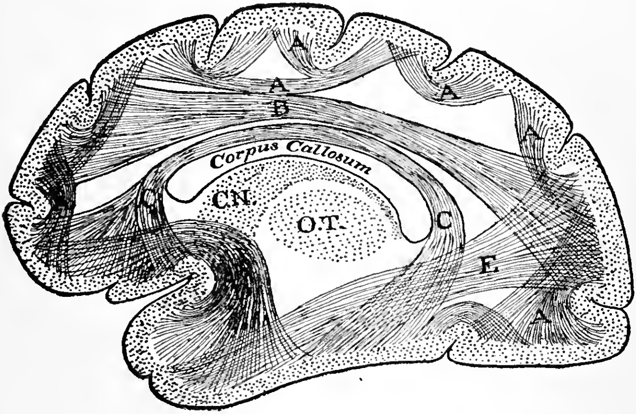


FIG. 9. Lateral view of a human hemisphere, showing the bundles of association fibers (*Starr*): *A*, *A*, Between adjacent gyri; *B*, between frontal and occipital areas; *C*, between frontal and temporal areas, cingulum; *D*, between frontal and temporal areas, fasciculus uncinatus; *E*, between occipital and temporal areas, fasciculus longitudinalis inferior; *C.N*, caudate nucleus; *O.T*, thalamus.—(*Howell.*)

nect, as a rule, adjacent convolutions; the long association fibers, marked B, C, D, E, in the figure, connect remote regions of the cortex. The functions of the association fibers are to distribute impulses brought to the cortex by the afferent (incoming) projection fibers, and to co-ordinate the activities of the different cortical areas.

The *commissural fibers* (Fig. 10) serve to connect the cortex of one hemisphere with that of the other. As may be seen from the figure, the commissural fibers, as they cross the line between the hemispheres, are collected into three bands known as commissures or bridges: (1) the corpus callosum, the chief bridge; (2) the anterior commissure, connecting the olfactory bulbs and the temporal lobes of the two hemispheres; (3) the hippocampal commissure, connecting the hippocampal gyri of the two hemispheres. (Only the first and third commissures are represented in the figure.

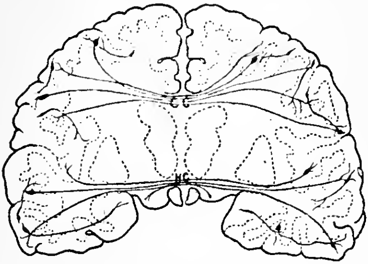

FIG. 10. Diagram showing fibres connecting the two cerebral hemispheres. (The anterior commissure is not represented in the figure.)

**The Three Types of Cortical Areas.**—It is possible to describe at least three types of cortical functional areas, and, in part, to localize them. The three types of areas are: (1) motor, which is directly concerned in the stimulation and control of the voluntary muscles; (2) the sensory, the areas in which sensory paths from the sense-organs terminate; and (3) the association areas whose function is to recombine and redistribute the impulses received in the sensory areas.

**The Motor Cortical Areas in Man.** — Until comparatively recently the motor zone was thought to occupy the pre-central and post-central convolutions on each side of the Rolandic fissure, and probably also the immediately adjacent areas. But at present, "the trend of opinion," as Taylor says, "is in favor of the view that the motor region is entirely or almost entirely in front of the central fissure of Rolando," (as represented in Figure 5, p. 25) and extending over the upper margin of the hemisphere on its mesial surface for a short distance. In the lower part of the motor zone are found the motor centres for the face, neck, tongue, and mouth; in the central part, centers for the arm (shoulder, elbow, wrist, fingers, and thumb); in the upper part of the zone are the centers for the leg (hip, knee, ankle, toes).

**The Sensory Cortical Centers in Man** most definitely located are: (1) the somæsthetic, or bodily sense, area; (2) the center for vision, and (3) the auditory center. The bodily sense (somæsthetic) area — that is, the region correlated with the cutaneous sensations of pressure, pain, cold, and warmth, with the kinæsthetic sensations, muscular, tendinous, and articular, and possibly with other organic sensations — lies in the post-central convolution and in the adjoining parietal convolutions. (See Figure 5, p. 25.) The general area for vision is located in the two occipital lobes. See Figure 5 for location of the visual area in left hemisphere. The auditory area probably lies mainly in the upper temporal convolution and in the transverse convolutions running into the Sylvian fissure. (See Figure 5 for probable location of the auditory center of the left hemisphere). "It is very likely," according to Taylor, "that the (auditory) center of each side is connected with both auditory nerves, so that a paralysis of one side by a unilateral lesion of one side may be compensated for by the center of the opposite side."[1] The cortical center for smell is believed to be in the front part of the hippocampal convolution (Fig. 6, p. 26); and it is often asserted that the center for taste is also in this convolution, posterior to the area for smell. But, as Howell remarks, "practically nothing definite is known concerning the central paths and cortical termination of the taste fibers."

**Cortical Association Areas.** — From an inspection of the accompanying figures and drawings of the hemispheres it will be seen that the sensory and motor areas of the cortex occupy only a small portion of the entire cortical area. The remaining portion is occupied by 'the association areas', as they have been designated by Flechsig. According to Flechsig, there are four of these areas: (1) the frontal, which lies in front of the motor areas, and occupies a large part of the frontal lobe; (2) the median, or insular, the cortex of the island of Reil; (3) the parietal, which lies posterior to the bodily sense area, and extends backward to the occipital lobe; and (4) the temporal occupying, as the name suggests, certain portions of the temporal lobe.

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[1] PIERSOL, *Human Anatomy*, vol. II, p. 1213.

**Function of the Association Areas.** — Knowledge concerning the function of the association areas of the human brain is derived principally from the study of the relationships which exist between definite disorders, due to accident or disease, of these areas and certain defects of the human mind. For example, the *post mortem* examination of the brain of a patient, who during life was afflicted with mental blindness — the inability to understand optical impressions — shows that the areas connecting the visual centers with other parts of the cortex are broken down, so that the optical impression awakens no images or ideas in regard to the object seen. If the object is a word such as 'orange' or 'horse,' it means nothing, the patient cannot recall the sound of the word, nor is he able to pronounce it. In this case the optical center may function normally, but the connections between it and the centers for hearing and articulation, and possibly other sensory centers, are ruptured, and the rupture occurs in the association areas. Again, in cases of mental deafness, the auditory center seems to perform its normal functions, but on account of the disturbance of the association areas between it and other cortical areas, the sounds which the patient hears mean nothing. For example, he hears the ringing of a bell, but it awakens no memories or ideas of how the bell looks, or of its name, or of how it would 'feel' to the hand, or of any of its other properties.

Cases of this sort, of which the books on neuropathology record a great many, strongly corroborate the general theoretical opinion that the function of the association areas is to connect the several sensory centers with one another and with the motor areas, particularly those of speech; further, and perhaps most important of all, their function is to connect the cortical processes correlated with sensations and images, thus constituting an essential feature of the nervous basis of perception and memory. It was such a variety of functions which James had in mind, perhaps, when he wrote:

> "Every namable thing, act, or relation has numerous properties, qualities, or aspects. In our minds the properties of each thing, together with its name, form an associated group. If different parts of the brain are severally concerned with the several properties, and a further part with the hearing, and still another with the uttering, of the name, there must inevitably be brought about . . . . such a dynamic connection amongst all these brain parts that the activity of any one of them will be likely to awaken the activity of all the rest."[1]

**The Localization of Cerebral Functions.** — The history of opinion in regard to the localization of cerebral functions may be divided roughly into four periods. To the first period — early part of the nineteenth century — belongs the system of phrenology of Gall and his pupil, Spurzheim, which was an attempt to localize a number of cerebral organs (Spurzheim localized thirty-five), whose individual and separate functioning is the condition of a like number of independent mental "faculties," "capacities," or "internal senses." (2) Gall's and Spurz-

[1] *Principles of Psychology*, I, p. 55. Compare p. 555.

heim's teachings fell into disrepute — first, because they came to be "exploited chiefly by frauds and charlatans," and, second, because of the experiments of Flourens, which seemed to establish the doctrine of the functional equivalence of all parts of the cerebrum, i. e., that one part can perform the functions of any other part, and that the whole cerebrum assists in the performance of each function. Flourens' views were generally accepted by the physiologists till the publication, in 1870, of Fritsch and Hitzig's studies, which marked the beginning of the third period. (3) These investigators found that by stimulating electrically definite regions of the cortex of the dog's brain certain definite, highly specialized movements resulted. Then came a renewal of interest in the localization question and a number of scientists of the first grade attacked the problem. Some of them worked by the method of stimulating electrically the cortical areas of various animals and of man; some, by cutting away portions of the cortex and observing the sensory or motor defects which resulted; others, by autopsies on persons in whom motor and sensory defects were found to be related more or less closely to morbid changes in definite cerebral areas. The brilliant successes of these various lines of study soon tempted men to pass beyond the domain of ascertained fact to the realm of speculation, and there arose a tendency to conceive of the human cerebrum as consisting of a multitude of separate organs, thus returning to a view resembling in some respects the older doctrine of Gall.

(4) The fourth period is best represented by Wundt's principle of relative localization as distinguished from the theory of 'absolute' localization. Wundt's theory rests upon and includes four other 'General Principles of the Central Functions,' which may be stated briefly, and, so far as possible, in his own words.[1] (1) The first of these is 'The Principle of the Connection of Elements.' This principle may be stated from the three standpoints of anatomy, physiology, and psychology. 'Anatomically regarded, the nervous system is a unitary complex of numerous elements; and every one of these morphological elements stands in more or less close connection with others.' 'Physiologically, the principle of the connection of elements implies that every physiological activity which is open to our observation and analysis, is composed of a large number of elementary functions . . . . . In particular, e. g., the physiological process underlying, however simple a sensation or muscular contraction is a complex process, involving the activity of many elementary parts . . . . . Lastly, there is a psychological, as well as an anatomical and physiological formulation of the principle. It means, psychologically, that the simplest psychical contents discoverable by analysis of the facts of consciousness (simple sensations or simple feelings) always presuppose, as their physiological subtrate, complex nerve processes, and the result of the coöperation of many elementary parts.

[1] *Principles of Physiological Psychology*, Eng. trans. by Titchener, 1904, vol. I, pp. 287 ff. 320 ff.

The principle just explained is opposed to the theory of the autonomy of the elements which is that the physiological nerve elements, the nerve cells, can mediate extremely complex psychical functions. 'Thus, according to this [latter] theory, a single cell may, according to circumstances, be the vehicle of a sensation or of a compound idea, a concept.' This theory, in its crudest form, attempts to estimate the number of ideas that, on emergency, may be lodged in an individual consciousness, by counting the number of cells in the cerebral cortex.

(2) The second principle is that of 'the Original Indifference of Functions,' namely, that the nervous elements originally were not specialized as to the functions which they should mediate. This principle is supported, anatomically, by the essential identity of structure that we find throughout the elements of the nervous system: 'physiologically, the principle of indifference of function is attested by the uniform character of the forces that reside in the nervous elements . . . . 'Lastly, the principle derives its principal support, on the psychological side, from the fact that the specific differences in the sensory contents of consciousness, if they are of an elementary nature, may always be resolved into qualities of sensation and feeling that depend upon the functions of peripheral elements,' and not upon the specific energies of the nervous elements within the cerebral cortex. Wundt admits that the so-called 'law of specific energy' still holds its own in current scientific thought, but predicts that its final statement will relate to the peripheral sensory elements.

(3) Wundt's third general principle of brain function is that of 'Practice and Adaptation.'

"Practice . . . . consists in the perfection of a function by its repeated performance. Hence the principle of practice, as applied to the functions of the nervous system, signifies that every central element, whether considered by itself or regarded as coöperating in some special way, determined by the conditions of life, with other like elements, becomes better and better fitted to discharge or to share in the discharge of a particular function, the more frequently it has been called to its service by pressure of external conditions." Practice is, therefore, to be looked upon as responsible for many of the changes which take place "in the nervous apparatus and their appended organs." Ordinarily the first effect of practice "is the perfection of a given function; but it may also lead to new combinations of elementary nerve processes by which the original nature of a complex function is altered and the function itself, in accordance with the general character of practice, moulded into new combinations as conditions may require. Under these circumstances the process of practice is termed "adaptation."

(4) "The Principle of Vicarious Function" is that under certain conditions nerve elements assume functions which they have not previously discharged, though they must, of course, have carried within them the latent possibility of their new offices.

(5) The Principle of Relative Localization. The following quotation shows how Wundt's four principles: (1) of connection of elements; (2) of orig-

inal indifference of functions; (3) of practice and adaptation, and (4) of vicarious function, support his Principle of Relative Localization in opposition to the hypothesis of an absolute localization:

"There can be no doubt that, in a certain sense, the central functions, [those of the cerebrum] like those of the peripheral organs, are spatially distinct. But there can also be no doubt that the central organ, as its name implies, represents, in contradistinction to the peripheral organs, a centralisation and thus, at the same time, an unification of functions; so that any absolute localisation of function, which should confine each separate activity within fixed limits, is *a priori* impossible, as it is also unsupported by the facts of observation. In the peripheral organs, where the demands of external function have produced diversity of structure, the principle of division of labour is strictly observed, and the localisation of function follows in the train of its observance. In the centres of the nervous system, the principle is broken through in two different ways. On the one hand, every central function divides . . . . into a number of subordinate and auxiliary functions, which of themselves embrace wide and, in part, widely remote areas of the central nervous system. On the other, the processes of practice, adaptation and vicarious function show that the spatial centralisation of a function is not fixed, but dependent upon its exercise, and upon the conditions under which this exercise is placed, so that any rigid spatial limitation is out of the question . . . . The principle of [relative] localisation also stands in the closest relation to the principles of the connexion of elements and of the original indifference of function. For without the connexion of elements that is required by every, even the simplest form of central activity, and without an original and, in the case of many central elements, a permanent functional indifference, there could be no shift of the limits of a function with change in its conditions. In fine, then, the principle of relative localisation gathers up and includes all the preceding principles, as its necessary presuppositions; while an absolute localisation of the central functions, such as is often-times assumed, comes into direct conflict with every one of them."

In brief, Wundt's doctrine of relative localization, in contradistinction to the theory of absolute localization, gives prominence to the idea of coöperation of the different cortical regions as the physical correlate of the various psychical activities. It follows that the terms 'central organ', 'speech center,' 'visual center,' and the like, cannot relate to any single region or point of the cortex, but rather to two or more cortical regions whose functions are coördinated.

This completes our outline of the structure and functions of the brain, the principal organ of consciousness. We may turn now to a brief study of:

The Spinal Cord.—Anatomically and functionally, the spinal cord is continuous with the medulla oblongata; but for convenience in description the former is defined as that portion of the cerebrospinal axis which lies in the vertebral or spinal column, popularly known as the "back bone." In the human adult the cord is about 17 inches long and about three-fourths inch in diameter, tapering at the lower end and terminating in a slender filament.

Viewed in cross-section the cord is seen to be almost divided into two symmetrical halves by fissures, one on its ventral and one on its dorsal side. (Fig. 11.) The cross-section shows further a central grayish H-shaped area consisting of a mesh of fibres and a multitude of nerve cells—the gray matter of the cord. Each half of this area is divisible into three parts: (1) The short, thick, roundish anterior horn; (2) the long, slender, posterior horn, and (3) the part lying between the horns and connecting them (See Fig. 11). The gray matter of the cord is surrounded by the white matter which

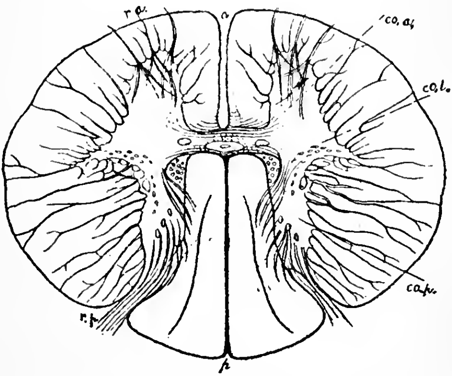


FIG. 11. Cross-section of the spinal cord: *a*, anterior fissure; *p*, posterior fissure; *co.a*, anterior horn; *co.l*, lateral horn; *co.p*, posterior horn; *r.a*, anterior and *r.p*, posterior roots of the spinal nerves. (After Ladd, modified.)

consists, exclusive of the supporting and connective tissues, of nerve fibres running lengthwise of the cord. The fibers are of three classes: (1) those which form paths of connection between the cerebrum and the sense-organs, the muscles and glands of the body, i. e., *ascending* fibres carrying sensory impulses to the cerebrum, and *descending* fibres conveying motor impulses to different bodily organs; (2) ascending and descending fibres which connect the gray matter of the cord with the cerebellum; and (3) fibres which connect different levels of the cord.

**Functions of the Spinal Cord.** — Structurally regarded, the spinal cord consists of (1) a system of reflex centers, and (2) multitudes of nerve fibres connecting different levels of the cord with one another and with the brain. Accordingly, the two principal functions of the spinal cord are: (1) to mediate reflex actions, and (2) to serve as a pathway for nervous impulses to and fro between the brain and the outlying parts of the body.

A pure reflex action is one which occurs immediately in response to the excitation of a sensory nerve and without conscious guidance. For example, if one tickles the sole of the foot of a sleeping child, the foot is withdrawn at once and without the child's "willing" so to act. In this case, the impulse set up by the tickling travels over a sensory neurone to a reflex center in the cord from which a motor impulse flows out to the muscles whose action causes the withdrawal of the foot. Suppose, however, that the child is awake; then the tickling stimulus results not only in the tendency to withdraw the foot as before, but also the consciousness of the tickling and possibly the idea of withdrawing the foot, hiding it, and the like. In the latter case, it is clear that the impulse which originated in the foot traveled first to the cord, thence up the cord to the brain cortex, finally resulting in a motor impulse downward from the cortex into the cord and

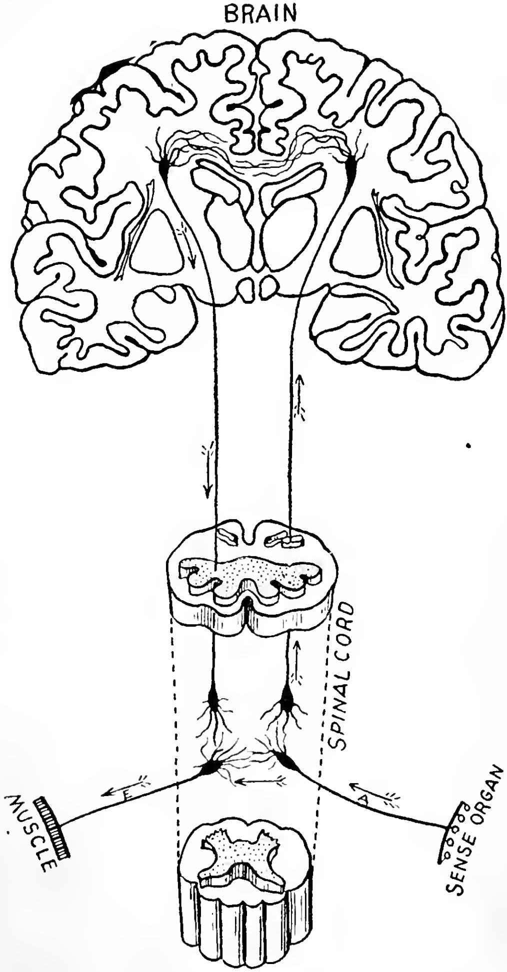


FIG. 12. Diagram showing principal functions of the spinal cord.

out to the muscles involved in withdrawing the foot. In the reflex withdrawal, the nerve current took a short route through a section of the spinal cord; in the voluntary, it took the long route by way of ascending tracts to the cortex, returning along the descending paths of the cord to the point of emergence, thence to the leg muscles.

The two principal functions performed by the cord as a system of reflex centres and as a pathway between different parts of the nervous system are illustrated in Figure 12, p. 47. The sensory ending of a nerve fibre terminates in the part marked, in the figure, "sense-organ." The stimulation of this organ excites an impulse which travels along the fibre *a* toward the cord as indicated by the arrow. Upon reaching the cord, the impulse may either pass over at once to a motor center in the cord and thence along the motor fibre *e* to the muscle, resulting in a reflex action; or it may pass upward, by a series of fibre connections, to the cerebral cortex, where it is transformed into a motor impulse which passes downward, and by another series of connections, terminating in the muscle.

It should be remembered that nervous action is rarely, if ever, as simple as that represented by the diagram and the foregoing description. The latter are intended merely to show in the simplest way the essential features of the two chief functions of the spinal cord, and incidentally the difference between an action which involves the brain and one which does not.

**The Peripheral Nervous System.** — So far in our study of the nervous system we have been concerned mainly with the central part—the brain and spinal cord. We have next to review the principal features of the peripheral nervous system, the part which serves to relate the various organs and tissues of the body to the central system.

The peripheral nerves may be grouped into two main systems: (1) the cerebro-spinal, and (2) the sympathetic. The former is divided into (a) the cranial nerves, which are attached to the brain, and (b) the spinal nerves, which are attached to the spinal cord.

**The Cranial Nerves.** — The twelve pairs of cranial nerves pass from the brain through small openings in the base of the skull to various parts of the head, mainly, though a few of them send branches to the respiratory organs, the heart, œsophagus, stomach and intestine. Figure 3 (p. 20) shows the superficial origins of the cranial nerves, i. e., the points at which they emerge from the brain. Some cranial nerves are wholly motor in function, i. e., convey only outgoing impulses from the brain; some are wholly sensory, i. e., convey only sensory impulses to the brain; others are both sensory and motor.

The cranial nerves are named either according to the structures or surfaces in which they terminate peripherally or according to their functions. The numbers, names, and principal functions of these nerves are given in the following table from Piersol.[1]

[1] Piersol, *Human Anatomy*, Vol. II, p. 1220.

## THE CRANIAL NERVES.

| NUMBER. | NAME. | FUNCTION. |
|---|---|---|
| I. | Olfactory: | Special sense of smell. |
| II. | Optic: | Special sense of sight |
| III. | Oculomotor: | Motor to eye-muscles and levator palpebrae superioris. |
| IV. | Trochlear: | Motor to superior oblique muscle. |
| V. | Trigeminal: | Common sensation to structures of head. Motor to muscles of mastication. |
| VI. | Abducent: | Motor to external rectus muscle. |
| VII. | Facial. | Motor to muscles of head (scalp and face) and neck (platysma). Probably secretory to submaxillary and sublingual glands. Sensory (taste) to anterior two-thirds of tongue. |
| VIII. | Auditory: | |
| | (a) Cochlear division: | Hearing. |
| | (b) Vestibular division: | Equilibration. |
| IX. | Glosso-Pharyngeal: | Special sense of taste. Common sensation to part of tongue and to pharynx and middle ear. Motor to some muscles of pharynx. |
| X. | Pneumogastric or Vagus: | Common sensation to part of tongue, pharynx, oesophagus, stomach and respiratory organs. Motor (in conjunction with bulbar part of spinal accessory) to muscles of pharynx, oesophagus, stomach and intestine, and respiratory organs; inhibitory impulses to heart. |
| XI. | Spinal Accessory: | Spinal Part: Motor to sternomastoid and trapesius muscles. |
| XII. | Hypoglossal: | Motor to muscles of tongue. |

**The Spinal Nerves**, of which there are usually thirty-one pairs, are attached to the spinal cord and emerge from the spinal canal through openings between the vertebræ of the spinal column, and pass to the various parts of the body. They are named according to the part of the vertebral canal from which they emerge. Thus there are eight pairs of *cervical* nerves, twelve pairs of *thoracic* nerves, five pairs of *lumbar*, five pairs of *sacral*, and one pair of *coccygeal* nerves. See Fig. 2 (p. 18) for the points of attachment of the spinal nerves to the spinal cord.

**The Sympathetic, or Autonomic, Nervous System.**—The second main division of the peripheral nervous system is the sympathetic, or autonomic, system, which comprises, according to Hardesty's classification:

"(1) the two chains of nerve gànglia, one on each side of the spinal column and running parallel therewith; (see figure 2, p. 18); (2) the great pre-vertebral plexuses, i. e., net works of nerve ganglia and nerve fibers lying in front of the vertebral column, of which there are roughly three,—one in the thorax, one in the abdomen, and one in the pelvic cavity (see fig. 13, p. 52); (3) the numerous terminal ganglia and plexuses situated either within or close to the walls of the various organs; (4) the trunks and fibre bands connecting the ganglia with each other, and thus contributing to the plexuses, or connecting the ganglia with other nerves or with the organs with whose innervation they are concerned."[1]

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NOTE. The name autonomic system, used by some authors, expresses the fact that this system is in a measure autonomous, independent of the central system.

[1] MORRIS, *Human Anatomy*, Part III, p. 1002.

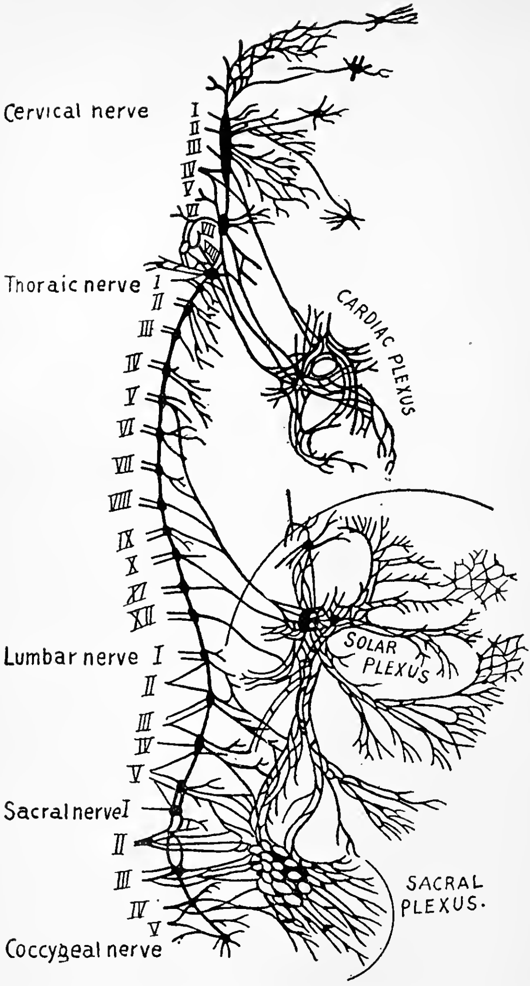


FIG. 13. The figure represents the coarser portions of the sympathetic nervous system and its principal connections with the cerebro-spinal system. (After Morris, modified.)

The sympathetic system differs from the cerebrospinal system, according to Hardesty, (1) in the fact that the cranial and spinal nerves are structurally continuous with the brain and spinal cord, while the fibres of the sympathetic system do not actually enter the central system; (2) "the cerebrospinal nerves are distributed to the ordinary sensory surfaces of the body and the organs of special sense, and to the somatic, striated, or "voluntary" muscles of the body; the sympathetic fibres (on the other hand) are devoted chiefly to the supply of the so-called involuntary muscles of the body, including the smooth muscle in the walls of the viscera and in the walls of the blood and lymph vascular systems, while some serve as secretory fibres to the glands."[1] From this it follows (3) that the sympathetic system is not under voluntary control. The organic processes which depend upon the sympathetic system, e. g., the movements of the stomach and intestines, the secretions of the digestive tract, heart action, breathing, contraction of the arterial muscles — occur reflexly, and, as a rule, unconsciously. We say, 'as a rule' because under certain conditions, as we shall see in our chapters on sensation, feeling, and emotion, the vegetative processes are accompanied by sensory and feeling experiences.

The psychologist, however, is interested in the sympathetic system chiefly because it is mainly through this (as a bond of connection between the cerebro-spinal system on the one hand and the organs of circulation, digestion, and respiration on the other) that the course of our mental life produces at times such marked changes in these organs; and because it forms part of the pathway whereby mental

[1] Morris, *Human Anatomy*, 899 f.

disturbances, particularly of the emotional type, are related to the functioning of these structures.

And, as Angell observes, it is 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 goes astray. Our consciousness is undoubtedly toned, as it were,

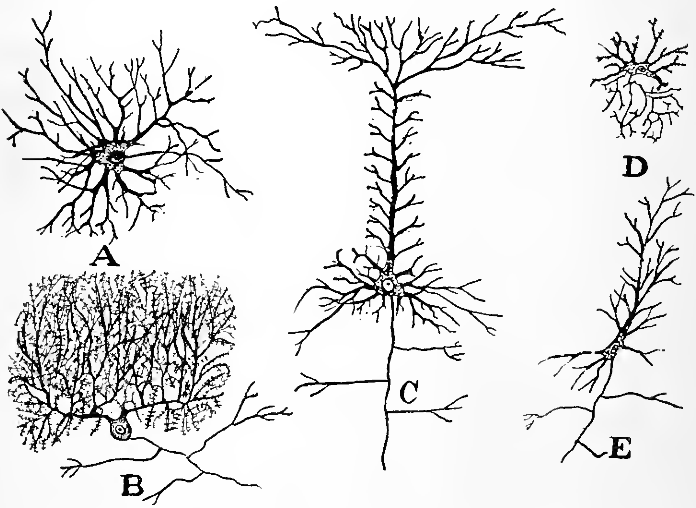


FIG. 14. Typical cell bodies of the neurones of the human nervous system. *A*, from the ventral horn of the spinal cord; *B*, Purkinje cell from the cerebellar cortex; *C*, pyramidal cell from cerebral cortex; *D*, Golgi cell from sp. cord; *E*, fusiform cell from cerebral cortex.

all the time by the condition and activity of the organs under the control of the autonomic system."[1]

In the preceding paragraphs of this chapter, we have endeavored to describe the general arrange-

[1] *Psychology*, 1908, p. 58.

ment of the human nervous system. We have also stated briefly those facts in respect to the structure and functions of those parts of the brain, the spinal cord, the cerebro-spinal nerves, and the sympathetic system, which are of most interest in an introductory course in psychology. It is next in order to study the *neurone,* the structural and functional unit of the nervous system.

**The Neurone.** — The nervous system proper, i. e., exclusive of the tissues which hold its parts in place and exclusive of the organs which nourish it, is composed of millions of thread-like bodies called 'neurones.' A neurone, or nerve cell, consists of the cell-body and the fiber-like structures called cell-processes, which are outgrowths of the cell body. The processes are of two kinds: (1) The dendrites, with their tree-like branchings, and (2) the axones, slender fibers, uniform in diameter, sometimes short, sometimes of great length, as where they extend from the brain cortex to the lower extremity of the spinal cord, or from the lower part of the spinal cord to the muscles of the foot. The branches from the axones, called collaterals, are at right angles to the main fiber, instead of branching tree-like as do the dendritic processes. See Figure 14, C.

Figure 14 gives an idea of the varieties of form of the cell-bodies and processes of typical neurones of the human nervous system. Figure 15, A-D, (p. 56) shows "the phylogenetic development of mature nerve-cells in a series of vertebrates; a-e, the ontogenetic development of growing cells in a typical mammal". Donaldson after Cajal.

**The Chief Groups of Neurones.** — From one point of view, the nervous system may be described as an

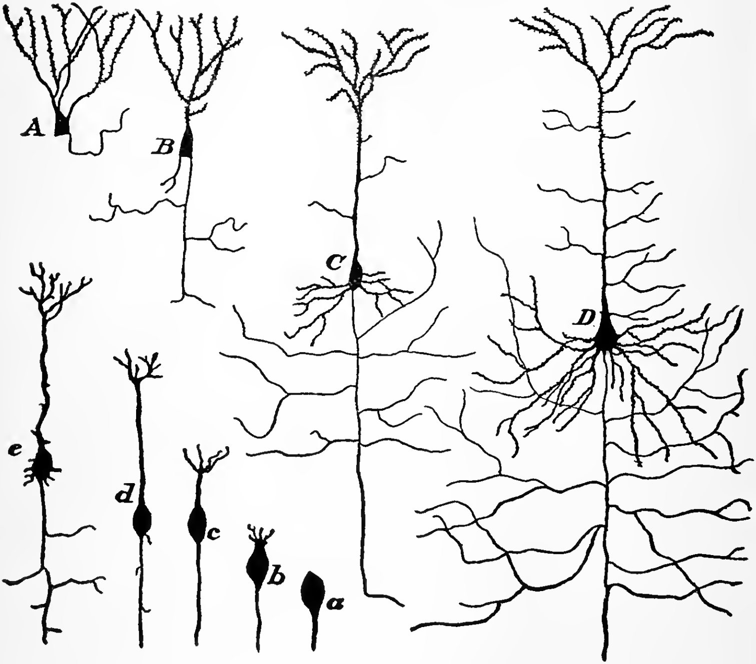


FIG. 15. *A-D*, showing the phylogenetic development of mature nerve-cells in a series of vertebrates; *a-e*, the ontogenetic development of growing cells in a typical mammal; in both cases only pyramidal cells from the cerebrum are shown; *A*, frog; *B*, lizard; *C*, rat; *D*, man; *a*, neuroblast without dendrites; *b*, commencing dendrites; *c*, dendrites further developed: *d*, first appearance of collateral branches; *e*, further development of collaterals and dendrites (Donaldson from S. Ramón y Cajal.)

apparatus which receives impulses from the outlying parts of the body, and which transmits these impulses to a central apparatus, the brain or spinal cord, where they are either transmitted directly, or recombined and then distributed, to the motor areas of the central bodies, whence they flow to the muscular or glandular tissues.

In accordance with this conception of the functions of the nervous system, the neurones are divided into three groups: (1) the *afferent,* or sensory, neurones, whose function is to receive and to transmit to the central nervous system impulses that originate in the sense organs; (2) the *associating,* or central neurones, whose function is to receive sensory impulses and to transmit them at once or to form them into new combinations, then to distribute them to (3) the *efferent,* or motor neurones, whose processes carry impulses to the muscles or to other bodily organs. In other words, there are (1) neurones which are affected directly by happenings in the environment, including the subject's own body; (2) neurones which carry impulses to the muscles and glands; (3) neurones which serve as paths of connection between the first and second groups.

**Sensory Neurones and Sense Organs.** — From the foregoing sketch it appears that the sensory neurones are essential parts of the apparatus for the excitation of sensations. In some cases, the neurones which mediate sensory impulses terminate peripherally in 'free' endings; in other cases, the peripheral termination of a sensory neurone is enclosed in a 'capsule'; in still others, it forms a part of an elaborate structure, such as the eye or

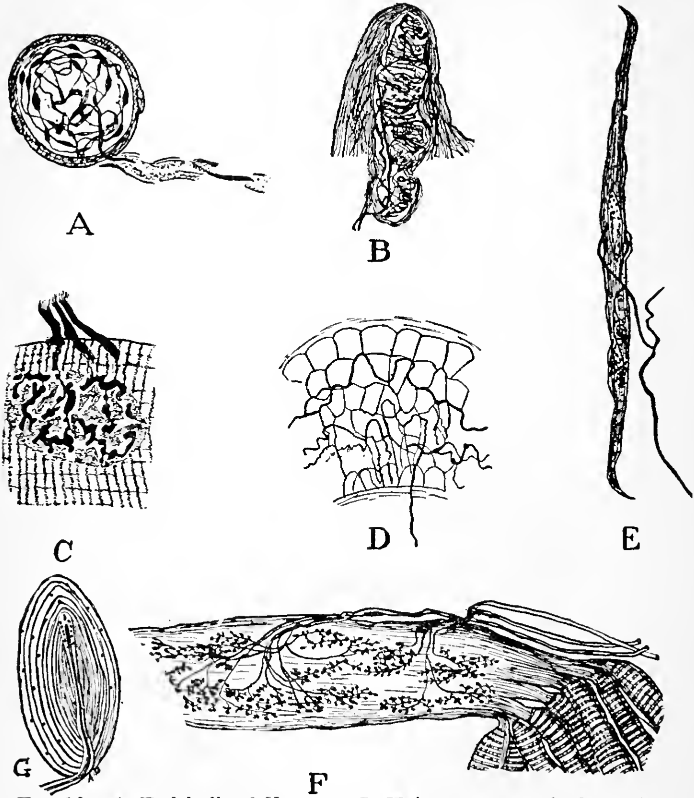


Fig. 16. *A*, End-bulb of Krause; *B*, Meissner corpuscle from skin; *C*, Motor end-plate on striated muscle cell; *D*, Free sensory nerve fibrils in epithelium; *E*, Motor termination upon smooth muscle-cell; *F*, Sensory nerve termination in tendon; *G*, Pacinian corpuscle. (After Morris and Davies.)

ear, especially arranged to control the effects of certain kinds of stimuli; all three classes of organs — the 'free' endings, the encapsulated sensory endings, as well as the more elaborate structures — are spoken of Sense Organs.

**Free Sensory Endings.** — These are found in vast numbers in the skin and mucous membranes. Figure 16, D, represents the mode of their termination. Titchener thinks it probable that the organs of pain are to be found in these free nerve endings.[1]

**The Encapsulated Sensory Endings.** — The nerve endings belonging to this group are alike in consisting of a net-work of terminal fibers, embedded in a fluid-like substance, and enclosed in a thin covering. The following are the best known structures of this class: (1) the end-bulbs of Krause; (2) Meissner's corpuscles; (3) Ruffini's corpuscles; (4) the Pacinian corpuscles; (5) the muscle spindles; (6) the tendinous spindles.

(1) The end-bulbs of Krause (Fig. 16, A) are found in the edge of the eyelid, the lips and the mucous membrane of the mouth, and in other highly sensitive tissues. Their function is possibly to mediate the sensation of cold.

(2) The Meissner corpuscles (Fig. 16, B) are most numerous in the skin covering the flexor surfaces of the palms of the hands and the soles of the feet. They are also distributed over the back of the hand and foot, the inside of the fore-arm, the lips, and certain parts of the genital organs. These corpuscles are the organs of the pressure (touch) sense on the hairless regions of the cutaneous surface.

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[1] A Text-Book of Psychology, p. 154.

(3) Ruffini's corpuscles are comparatively large bodies and lie in the deeper layers of the skin. These organs perhaps mediate the sensation of warmth. (Titchener).

(4) The Pacinian corpuscles (Fig. 16, G), the largest and the most complex of the sense-organs described thus far, are found, in man, to quote Piersol, "in the deeper layers of the connective tissue layer of the skin, especially on the palmar and plantar aspects of the fingers and toes, in the connective tissue in the vicinity of the joints, in tendons, in the sheath of the muscles, in the periosteum and tunica propria of the serous membranes, the peritoneum, pleura and pericardium." Pacini's corpuscles are supposed to be pressure sense-organs.

(5) The muscle spindles, following Piersol's description, "lie within the connective tissue separating the bundles of voluntary muscle fibers and are long spindle-shaped structures, varying in length from 1-5 mm., or more, and in width from .1-.3 where broadest. They are widely distributed, being probably present in all the skeletal muscles, and are especially numerous in the small muscles of the hand and foot." The muscle spindles are possibly the seat of 'the dragging, sore, tired sensations' which occur when the muscle is pressed firmly or when it "is thrown into forced contraction by the electric current." (Titchener.)

(6) The tendinous spindles are also spindle-like structures, from 1-1.5 mm. in length, found in the region where the muscles and tendons join. In regard to the function of these organs, Titchener says, in substance, the sensation of strain, which comes

in all cases of severe or prolonged muscular work, appears to come from the tendons and to have its organs in the tendinous spindles.[1]

**The Special Sense Organs.**—It was said above (p. 57) that the sensitive part of every sense-organ consists of the peripheral termination of a sensory neurone (or neurones) existing either as 'free' nerve-endings or as encapsulated bodies or as the sensory element of the more complicated structures commonly known as the special sense-organs, the organs of taste, smell, sight, and hearing. In the paragraphs immediately preceding we have noted certain typical structures that belong to the first two groups. We may next consider briefly the termination of the sensory neurones in the special sense-organs.

**Organs of Taste.**—The nerves of taste terminate peripherally in bodies called 'taste-buds,' which are distributed chiefly over the tip, the borders, and the posterior portion of the upper side of the tongue. The taste-buds consist of two classes of cell-elements, the gustatory cells, or taste cells proper, and the supporting cells. The typical arrangement of the two classes of cells within the taste-buds is shown in Figure 17.

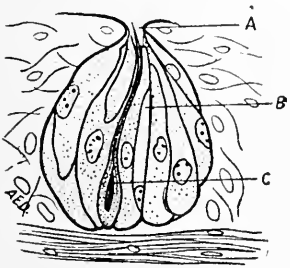


FIG. 17. Taste-bud. *A*, taste-pore; *B*, supporting cells; *C*, gustatory cell.

[1] *A Text-Book of Psychology*, §§ 38-50.

The nerves of taste enter at the base of the taste-bud, then rapidly subdivide into fibrillæ which wind their way among the cells and terminate in free endings which are often in contact with the gustatory cells. Sensations of taste originate in the action of chemical changes in the gustatory cells upon the adjoining nerve fibrils. The excitation of the fibrils is transmitted to certain nerve cells or ganglia, thence to the brain cortex.

**Organ of Smell.** — The olfactory fibres terminate in the olfactory cells, the end organs for the sense of smell. These cells are distributed over a small area in the upper part of the nasal chamber. The relations of the olfactory cells to the surrounding tissues are shown in Figure 18.

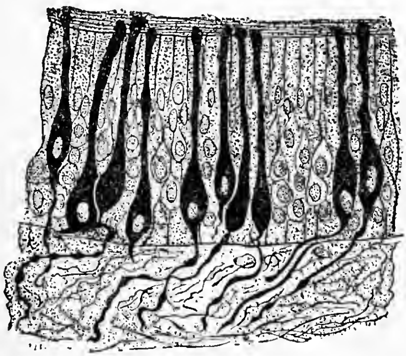

Fig. 18. Section of olfactory mucous membrane (after V. Brunn): the olfactory cells are in black.—(*Donaldson.*)

**The Termination of the Branches of the Auditory Nerve.** — The student may recall that the auditory nerve consists of two portions: the cochlear, which transmits sound impulses, and the vestibular, which is concerned with peculiar sensations from the semi-circular canals and vestibule that have an important influence on muscular activity, especially in complex movements.' The fibres of the cochlear branch end in terminal arborizations which lie in contact with the cells of the organ of Corti, an elaborate structure situated in the cochlea. Physiology teaches that sensations of sound are due to the effect which sound waves produce upon the sense-cells of this organ. The fibres of the vestibular branches of

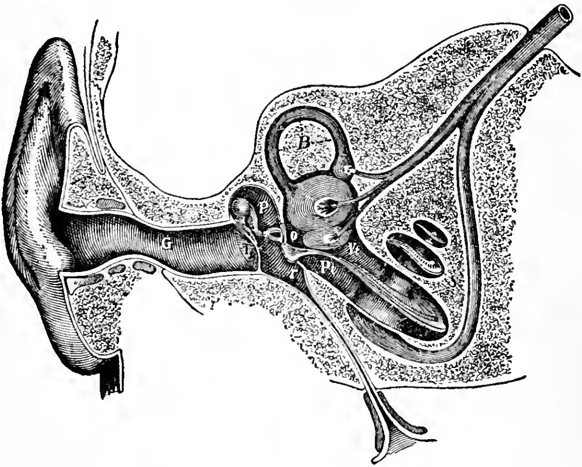


FIG. 19. Semidiagrammatic section through the right ear (*Czermak*): *G*, External auditory meatus; *T*, membrana tympani; *P*, tympanic cavity; *o*, fenestra ovalis; *r*, fenestra rotunda; *B*, semicircular canal; *S*, cochlea; *Vt*, scala vestibuli; *Pt*, scala tympani; *E*, Eustachian tube.

the auditory nerve terminate in certain membranes of the vestibule and the semi-circular canals of the inner ear. (Fig. 19 shows a semi-diagrammatic section through the right ear.)

**The Termination of the Optic Nerve Fibres.** — The nerve fibres composing the optic nerve spread radially from the point at which the optic nerve pierces the choroid coat of the eye-ball, forming a thin film known as the retina, which covers the inside of the posterior surface of the eye-ball. (Fig. 20). The retina, which contains the organs whose stimulation gives rise to the visual sensations is

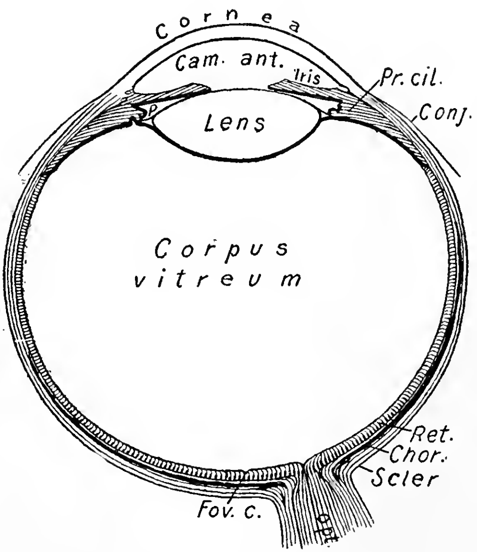


FIG. 20. Horizontal section through the left eye. (From Ladd's Elements of Physiol. Psych. Fig. 48, modified.)

composed essentially of nine layers of nerve cells and fibres, the innermost being the layer of nerve cells known as rods and cones. See Figure 21, which shows a diagrammatic section of seven of the layers of the retina.

Physiology teaches that the rods and cones contain chemical substances which freely change under the influence of light waves, and that the changes thus induced start impulses which traverse the outer layers of the retina to the radial branches of

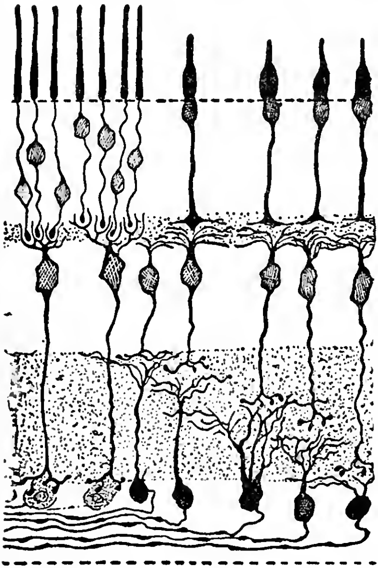


FIG. 21. Diagrammatic representation of the structure of the retina (Cajal): *A*, layer of rods and cones; *B*, external nuclear layer; *C*, external molecular (or plexiform) layer; *E*, internal nuclear layer; *F*, internal molecular (or plexiform) layer; *G*, layer of ganglion-cells; *H*, layer of nerve-fibres.

the optic nerve, and are then transmitted along the latter to the optical centers of the cerebral cortex giving rise to the sensations of sight.

This section began with the statement (p. 57) that the human nervous system consists essentially of three classes of neurones: (1) those concerned with the transmission of sensory impulses; (2) those which convey motor impulses from the brain and spinal cord to the outlying parts of the body; (3) those connecting the sensory and motor neurones. In the preceding paragraphs, we have studied the sensory neurone as a sense organ, and we have learned something of the variety, and, in certain instances, the complexity, of the organs involved in the process of gathering and transmitting sensory impulses. It remains to state more definitely the structural and functional relations of the motor and the associative neurones.

**The Motor Neurones and Motor Organs.**—The motor neurones terminate peripherally either in the voluntary muscles, those which are under conscious control, or in the non-voluntary, e. g., the muscles of the walls of the blood vessels or of the intestine which are not subject to conscious control. In the voluntary muscles the neurones terminate in minute oval-shaped bodies called end-plates. (See Fig. 16 C, p. 58). In the non-voluntary, the axones terminate 'in minute terminal knots on the surface of the muscle-cells', Fig. 16, E. (Piersol). In voluntary movements, the nervous impulse causing muscular contraction terminates in the end-plate.

**The Associative Neurones.**—According to the view developed in this text thus far, the primary function of the nervous system is to enable an animal, human or other, to make the appropriate responses to the environmental influences so that on the whole it shall prosper and its days in the land shall be long. And we have seen that the higher organisms are provided with an elaborate apparatus for receiving impulses from the outside world, and also with motor machinery for responding to these impulses. We have seen also that the sensory neurones form an essential feature of the former, the receiving apparatus, and that the motor neurones are likewise essential to the latter. We have next to recall that in the higher organisms the path from the terminus of the incoming impulse to the point of origin of the outgoing, or motor, impulse is often long and tortuous, and that the paths are formed by the structures already referred to as the association, or central, neurones. These bodies lie wholly within the central nervous system and their function is to distribute incoming impulses to other parts of this system. And it is possible through their mediation, as Thorndike says, that almost any kind of sensory stimulus — visual, auditory, pain, warm, gustatory, what not — may be connected with any set of motor cells and so influence any bodily act.[1]

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[1] *Elements of Psychology*, 1905, p. 149.

# CHAPTER III

## SENSATION IN GENERAL[1]

**Definition.** — If the student should search out and compare the definitions of Sensation in a series of representative modern text-books of psychology, his first impression would be that there is but slight similarity among them. Thus, one author stresses the fact that sensation is a form of consciousness which depends upon the stimulation of a sense-organ by some agency outside the nervous system; another, that sensation makes us acquainted with the qualities of the objects which stimulate these organs, e. g., the sourness of lemonade, the greenness of the grass, or the coldness of ice; a third author emphasizes the fact of the elementariness, or simplicity, of sensations as compared with, e. g., perceptions and memories; still a fourth, thinking for the time being about the order of the appearance of the various kinds of conscious experience in the developing mind of the child, defines sensation as 'the first thing in the way of consciousness.' Now all these authors are describing the same mental phenomena, but they are describing them in different ways because their points of view or purposes differ. One emphasizes one distinctive feature of sensation;

[1] The discussion of Sensation and of the Classes of Sensations in this and the following chapter follows, in the main, Titchener's treatment of these topics in his *Text-Book of Psychology*, §§ 10-59.

a second, another, and so on — the fact being that a complete definition of sensation includes an enumeration of all the four characteristics just mentioned, and possibly others. We may say, then, that sensations are those elementary conscious processes which are in immediate dependency upon the stimulation of the sense-organs, that they are essential to our knowledge of the outside world, including our own bodies, and that, temporally regarded, they are the earliest forms of consciousness. Each of these four items of our definition, which are, as we have seen, so many ways of regarding sensations, requires a few further words of explanation. And first of —

**Sensations as Mental Elements.**—This way of conceiving of sensation is employed chiefly by those psychologists who study the mental life from the structural point of view as described above (p. 7f.). Indeed, the words 'element' and 'elementary' are primarily structural terms; they suggest make-up, constitution. So to describe sensations as mental elements involves the additional view that in the analysis of our complex consciousnesses, our perceptions, memories, imaginations, into their simplest, most elementary parts, we shall come upon sensations, upon colors, sounds, tastes, odors, which resist all further effort to resolve them into simpler parts.

The meaning of the statement that sensation is a structural element of consciousness may be made clearer, perhaps, by remarking that it relates solely to a mental phenomenon or process, and not to something outside the mind, to things of the material world. Thus 'red,' as a sensation element, is a red consciousness, so to speak, not a red something which one sees in the external world; and a sensation of cold is not a sensation of a cold something, but a cold consciousness. To quote Titchener, "The sensation 'blue' (as a structural element of consciousness) does not tell us of a blue object' . . . . . It simply presents itself as a mental irreducible . . . . . . If the student insist, as at first he may, that he cannot possibly think of a 'blue' that is not a 'blue something'—remind him that "he is not to 'think of' blue at all, but to be a blue; his consciousness is to be a blue consciousness." The sensation 'blue' is to be stripped 'of all the overlay of associated processes that make 'blue' mean 'the blueness of something' in everyday life."[1]

Furthermore, it should be borne in mind that when the psychologist speaks of sensations as mental elements, he does not mean little particles or atoms of mind which can be separated out from the total consciousness, as one may separate the beads on a string. Not only is this way of conceiving of a mental element preposterous in itself; but when once lodged it straightway becomes the source of several psychological absurdities. One of these resulting false notions is that strong, intense, voluminous sensations are composed of a number of smaller, weaker sensations; that, for example, an intense bitter consists of a number of weaker bit-

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[1] *Experimental Psychology*, 1901, Vol. I, p. 4.

ters, a loud tone of a fusion of fainter tones. In truth, each sensation, whether faint or intense, tiny or voluminous, momentary or prolonged, is in James' words, "a complete integer, an indivisible unit."

A second erroneous notion that arises easily from the supposition that mental elements are real bits or fragments of mind, existing at first isolatedly, is that mental development consists in the gradual aggregation of these elements. The truer view is that at first the baby's mental experience consists of a vague, confused mass of sensations and feelings; and that 'the world of sense', as Thorndike writes, 'comes not as a building constructed of small pieces of bricks and mortar and glass, but as a landscape gradually clearing up from the obscurity of a fog."[1]

(2) Sensation and Sensory Stimulus. — Sensations are distinguished from other mental phenomena by the fact that they depend entirely upon impulses originating in the stimulation of the sense-organs. The stimuli, which are always external to the nervous system, may originate either outside the body or in some change in the internal bodily organs. Sound waves, the stimuli to hearing, are external stimuli; the changes in the digestive tract which cause hunger are internal stimuli.

A 'stimulus' may be defined as an agency outside the nervous system and acting upon it so as to cause either a sensation or a movement of some part of the body or both. A liminal, or just noticeable, or minimal, stimulus is one whose intensity is so weak, or whose duration is so brief, or

[1] *Elements of Psychology*, 1905, p. 22

whose extent or area is so small, that it is barely sensible. A terminal, or maximal, stimulus, is one whose increase either in intensity or duration or extensity no longer produces any change in consciousness. A subliminal stimulus is one which is too weak or too brief or too small to be sensed.

In this connection it is important, as Stout remarks, "to distinguish the cause, i. e., 'the essential antecedents' of sensation from the object of sense-perception. . . . The colour sensation, for instance, is due to a vibratory motion of the particles of the luminiferous ether, giving rise to certain chemical or physical changes in the organ of vision, and so to a certain modification of connected parts of the nervous system. But these conditions are not what a man sees when he perceives the color red or blue."[1] Similarly, we must distinguish the sounds which one hears when a bell is rung from the succession of sound waves (the stimulus) and the changes, 'the essential antecedents' of the sound sensation, which they produce in the organ of hearing and the connected parts of the nervous system.

**(3) Sensation and Knowledge of the Outside World.** We have seen that some psychologists define sensation as the consciousness of the qualities of material things, as of redness, blueness, coldness, sweetness, and so on. In this case, emphasis is laid upon the cognitive, or knowledge furnishing, function of sensations. "Sensations," we are told, "make us acquainted with innumerable material things." Possibly this way of conceiving of sensation may be

[1] STOUT, *Manual*, p. 118 f.

made clearer by considering the answer which you probably would give to the question, "How did you learn of the existence of the things which make up the physical world, the things of earth and sky, plants, animals, clouds, the moon, the stars?" You would say, very likely, "through the senses," and your answer, while partial and incomplete, would be correct in the meaning that sensations are the essential elements, the raw material out of which your knowledge of the existence of the material world is constructed, and in the sense that without the matter given in sensation, you could have no such knowledge. A familiar illustration of the dependency of our knowledge of the external world upon sensations is found in the fact that a person blind from birth would never learn, unaided, of the existence of the moon and stars. Likewise, for a deaf-born person, soft music or thunder does not exist. Illustrations of this sort make it seem a mere commonplace to say that sensation is a necessary element of our knowledge of the physical world.

It is of interest to note certain differences among sensations in respect to their value as basic material for knowledge of the external world. Contrast, for example, sight sensations with those of hunger, or thirst, or nausea. The former clearly "make us acquainted" with innumerable outside things, while the latter tell us little or nothing about the objects of the material world. In general we may say that the sensations of the special senses are rich in the elements of knowledge of things outside the body, while the organic sensations are poor.

(4) Sensations as the Earliest Forms of Consciousness.—If we were able to recall the mental experiences of the first days or hours of our lives, prob-

ably we should find that they consisted largely of sensations, or rather of sensation masses. The baby's brain is at first wrapped in deep slumber, then roused to action by nerve impulses from sense-organs, whereupon the 'miracle of consciousness' bursts forth in the form of sensation. Accordingly, from the genetic point of view, sensations are marked off from other forms of mental experience as the first things in the way of consciousness.

**Pure Sensations.** — "Pure sensations," says James, "can only be realized in the earliest days of life. They are all but impossible to adults with memories and stores of associations acquired." Sensations springing up in the adult consciousness are forthwith referred either to the objects which are thought to cause them, or to some part of the body. Thus, the mental changes due to the rumble of a passing wagon, or to glancing out of the window at adjoining buildings, or by an air current laden with odors from a bakery, awaken images or ideas of the wagon on the street, of houses out there, of the bake-shop across the way. In ordinary speech we say that the sensations suggest or revive the ideas of the objects which cause them. This occurs in the mind which has reached a certain stage of development. But it seems probable that in the first days or weeks of a baby's life its consciousness consists of nothing but sensations, or sensation complexes, (plus their accompanying feelings of pleasantness and unpleasantness), a mere sequence of flashes or shocks of lights and sounds, of touches and tastes, now a twinge of pain, now a pungent odor, now a sweet or bitter taste, now a shudder of cold, each pulse of sensation being independent of every other, inviting no comparisons, suggesting nothing, fading out and leaving no traces and so no memories of its having been — each one merely appearing in the wake of the appropriate physical processes and disappearing, leaving not a wrack behind. Such a mind would consist of a series of bare sensations, isolated from everything else in the world. Here we should find our 'pure' sensations, here we should find the experiences indicated by Condillac's striking phrase, quoted by James, "the first time we see light, we *are* it rather than see it."

It seems likely that the mental life of many of the lower animals consists wholly of a series of pure sensations, in the sense just described. A sensation in these creatures leaves no traces, it enters into no associations, it awakens no memories of former similar objects or experiences; its function is exhausted in exciting its appropriate motor response.

**The Differentiation of Sensory Qualities.** — The consciousness resulting when nerve currents from a number of sensory sources pour into the newborn infant's brain is vividly pictured in James' oft-quoted sentence — "the baby, assailed by eyes, ears, nose, and entrails at once, feels it all as one big, blooming, buzzing Confusion." Probably impressions from the organs of taste, temperature, pressure, pain, and possibly others, reach the cortical areas from the first; but their total effect in consciousness is a vague, undifferentiated sensation mass. Now, in the course of mental development, the individual's sensory experience undergoes differentiation, and this process follows in the main two directions. First, the great classes of sensations emerge; visual sensations, e. g., are no longer merged in a vague total consciousness, but gradually acquire distinctness and separateness in the infant's mental life. So with the other great groups of sensations — auditory, gustatory, olfactory, and so on; each group is differentiated step by step from the other groups.

Of course at this stage the child does not think of the differences themselves; he does not reflect, 'this experience is different from the immediately preceding one'. Thoughts of this kind belong to a distinctly higher level of mental development; they are sometimes called acts of conscious discrimination. Perhaps the distinction between the differentiation of sensory experiences and the consciousness of difference between two sensations may be expressed by saying that in the former process different sensations are experienced, while in the latter the nature of the difference is the subject of thought. In the former case, the difference exists in consciousness, but it is not an object of consciousness.

A second form of differentiation of sensory experience consists in the appearance of distinctions within the several sensation groups. For instance, the consciousness of blue is, in time, marked off from that of green; that of yellow, from orange; sour, from bitter; ethereal, from aromatic. Now, the capacity to experience more and more sensory qualities within the same sensation group reaches a very high degree of development, particularly in the fields of vision and hearing. Thus it is possible to distinguish more than 30,000 visual qualities and more than 11,000 different tones. Again, in addition to the fundamental distinctions of the qualities of sensory experiences, distinctions of sensational intensity, extensity, and duration, gradually make their appearance, and with these the development of the individual's capacity for experiencing sensation differences is completed.

**The Attributes of Sensation.** — In everyday speech the word 'attribute' may relate either to the essential or to the non-essential properties of objects. In the former case, the term refers to something without which a given object would cease to be; in the latter, it refers to something which seems to be attached, or added, to the essential stuff of which the object is constituted, and it may or may not be present. Thus it is an essential attribute of glass that it shall have weight; but brittleness, pliability, transparency, and opacity are classed among its non-essential attributes. Again, fluidity is an essential attribute of water; with the disappearance of this attribute, water as water no longer exists, while coldness and warmth are two of its non-essential properties or attributes. Now, when the psychologist speaks of the 'attributes' of a sensation he means its essential properties, those without which the sensation cannot come into being, those whose disappearance involves also the disappearance of the sensation. Thus it is clear that the reduction of any sensation's intensity to zero involves the disappearance of the sensation itself. Accordingly, intensity is included in the list of its essential properties or attributes. In short, a sensation's attributes are inherent, and not adherent.

We may next enumerate and describe briefly the several attributes or essential properties of sensations. Psychologists differ slightly as to what shall be included in such an enumeration, but we shall be on safe ground if we accept Titchener's list, which includes — quality, intensity, clearness, duration, and, in the case of certain sensations — extent.

**Quality.** — Sensations are distinguished, named and classified primarily according to their qualities. Thus blue, red, salt, bitter, cold, warm, are names of sensation qualities; the most obvious and striking differences and likenesses among sensations are differences and likenesses of quality. Again, quality is the basis of the classification of sensations as visual, auditory, olfactory, gustatory, and so on. 'Quality,' says Külpe, 'is the very essence of a sensation.' For these reasons some psychologists call quality the 'fundamental' attribute of sensation; other psychologists, for similar reasons, call it the distinguishing, individualising sensation attribute.

**Intensity.** — Every sensation has, besides its distinctive quality, a certain intensity, or strength. Thus a given sensation of taste or sound or temperature may be extremely weak, barely sensible; or it may be of any degree of intensity between the lower limit where it is barely sensed and the upper limit of sensibility where it either ceases to grow in intensity or gives place to some other experience. Such expressions as — extremely cold, intensely bitter, barely warm, very faint (of sound) — relate to the attribute of intensity of these several sensations.

**Clearness.** — We compare sensations in respect to the attribute of clearness when we say that one is in the 'focus' or foreground of consciousness and that another is in the 'margin' or background. Sensations vary in respect to the attribute of clearness between the lower limit of the extremely obscure, the barely noticed, and the upper limit of clearness, where the sensation is the only thing in consciousness, where the sensation of the moment and consciousness are identical.

**Duration: Extent.** — "Duration is the attribute of sensation that we attend to," says Titchener, "when we answer the questions: How long does it last? When does it appear? Has it gone out yet? Is it steady or interrupted?"

Besides the four attributes just mentioned, certain classes of sensation have also the attribute of extent which, to quote Titchener further, "is the aspect of sensation that we attend to when we are called upon to answer the questions . . . . . how large is it? what shape has it? is it regular or irregular? large or small? continuous or patchy? uniform or broken?"[1]

Next we may inquire, have the various classes of sensations the same attributes? And we answer, still quoting Titchener: "All sensations, without exception, possess the attributes of quality, intensity, clearness and duration." Only two groups of sensations—those of sight and pressure—have, beyond question, also the fifth attribute of our list, namely,

[1] *Elementary Psychology of Feeling and Attention*, 1908, Lecture I.

extensity. For example, it would seem as nonsensical to inquire concerning the area or extent of a given odor or taste, as it would to ask, what color is it? Area, or extent, is not an attribute of the sensations of either smell or taste. On the other hand, it seems natural to describe visual and pressure sensations as extended. Indeed, to think away the extensity, or area, of a visual or pressure sensation is to think away the sensation itself.

**The Classification of Sensations.**—Sensations may be classified conveniently, though roughly, by reference to the bodily organs immediately concerned in their production. Thus we have eye sensations, ear sensations, nose sensations, sensations from the circulatory system, and so on. Sensations may also be classified on the basis of their qualitative resemblances. This principle is useful particularly in classifying the sensations from the so-called special sense-organs — the eye, ear, nose, mouth, tongue, and skin. Finally, sensations may be classified according to the stimuli which evoke them. In this case, sensations would fall into two great groups: (a) sensations from external stimuli, and (b) sensations whose stimuli consist in changes in the internal bodily organs. But it must be said that in the present state of our knowledge, it is not possible to make an entirely satisfactory classification of the sensations, even by employing freely the three principles just stated.

The table which follows makes no pretension of being scientifically complete; but it may give the student a provisional and general idea of the main divisions of the field of our sensory experience. The first five groups of the table are called Sensations of the Special Senses; the remaining seven groups are Organic Sensations.

| SENSE ORGANS. | SENSATIONS. |
|---|---|
| 1. The rods and cones of the retinae. | Visual sensations: (a) brightness, (b) color. |
| 2. The cochlea of the internal ear. | Auditory sensations: (a) noises, (b) tones. |
| 3. The nose. (The olfactory cells). | Olfactory sensations: (a) ethereal, (b) aromatic, (c) fragrant, etc. |
| 4. The tongue, parts of the mouth and palate. (The taste buds). | Gustatory sensations: (a) sweet, (b) sour, (c) salt, (d) bitter. |
| 5. The skin. (The encapsulated sensory nerve endings; free nerve endings, see p. 59f). | Cutaneous sensations: (a) pressure, (b) warmth, (c) coldness, (d) pain. |
| 6. Vestibule and semicircular canals of the internal ear. | Sensations of movement and position. |
| 7. The muscles. | Muscular sensations: (pressure, fatigue?) |
| 8. The tendons. | Tendinous sensations. |
| 9. Surfaces of the joints. | Articular sensations. |
| 10. The alimentary canal. | The complex sensations of hunger, thirst, nausea. etc. |
| 11. The circulatory system. | The complex sensations of throbbing, oppression, shivering. |
| 12. The respiratory system. | Sensations of stuffiness, suffocation or of freshness and vigor. |

# CHAPTER IV

## CLASSES OF SENSATIONS

### VISUAL SENSATIONS

**Classes of Visual Sensations.**—There are two great systems, or series, of visual sensations—the color, or chromatic, series and the white-gray-black, or achromatic, series. The color system includes: (1) The principal colors—red, yellow, green, blue; (2) the intermediate hues, e. g., orange, olive, blue-green; (3) the sensations due to variations of tint and shade, e. g., pink, pale-green, brown; (4) the sensations due to variation of saturation or chroma, e. g., pure red, grayish red, pale, washed-out red. The achromatic system, known also as the brightness or light series, includes all distinguishable blacks and grays and whites from the deepest black to the brightest white.

The normal human eye is capable of distinguishing about 700 qualities of brightness sensation ('shades of gray' they are called sometimes) when they are arranged in a single series running from the deepest black to the most brilliant white. When all possible color-tones or hues, together with all possible variations of tint and shade and saturation are counted, we have more than 30,000 qualities of color.

In our ordinary visual experience, the brightness series and the color series are so closely interrelated that neither the difference between them nor their relative independence is noted. The nearest approach which Nature furnishes in human experience to a demonstration of the distinction is given (1) in the colorlessness of highly colored objects in peripheral vision, i. e., when they are seen 'out of the corner of the eye,' with the outer retinal zone; (2) in twilight vision, when the colors of objects about us fade out and the objects are seen as gray; (3) in cases of total color-blindness, where the subject's visual world contains no trace of color, but consists solely of varying degrees of blackness, grayness, and whiteness. But here the color system is not felt as different; it is simply non-existent.

Two further observations which support the two-fold classification of visual sensations may be noted. One is that, in the ascending scale that marks the stages in the evolution of the organ of sight, apparatus responsive to brightness differences appears before that which is responsive to color differences. The most primitive form of the eye is sensitive to variations of illumination, but is insensitive to variations of color. Thus the so-called eye-specks of the jelly fish are sensitive to the difference between light and dark, black and white, but not to mere color changes. Further, students of animal behavior find many species of animals that have visual apparatus which is responsive to changes within the brightness series but which, apparently, is not affected by changes in the color series. Obviously, such observations support the two-fold classification of visual sensations. Secondly, the relative independence of the two systems of visual sensations appears from the fact that, while every known color is interfused with some grade of brightness, there are many objects which show no trace of color; they are white or black or some intermediate shade of gray.

**The Color Pyramid.**— The two systems of visual sensations, the brightnesses and the colors, together with their interrelations, are represented by the double color pyramid. (Fig. 22). The figure consists, it will be observed, of two pyramids whose bases coincide. The dotted vertical line, connecting the two apexes, represents the white-gray-black series; that is, we may think of all distinguishable grades of brightness between the deepest black and the brightest white as being arranged along this line. . . . . . . The capitals, R. Y. G. B., at the four corners of the base stand for the principal colors — red, yellow, green, and blue; the capitals, V. P. O. YG. and BG. on the lines connecting the four corners of the base, represent a few of the distinguishable intermediate hues — violet, purple, orange, yellowish-

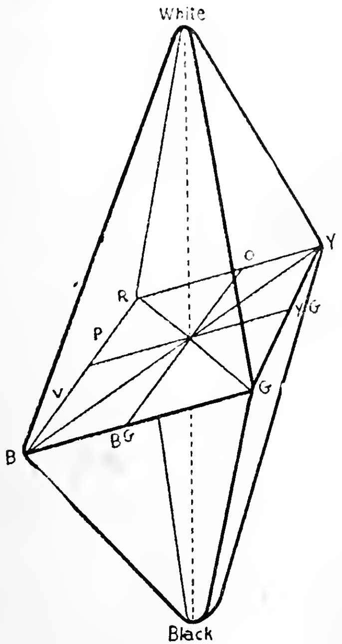


FIG. 22. The Color Pyramid. (After Titchener; A Text-Book of Psychology, Fig. 2.)

green, blue-green — of which there are in all 150 or more. The lines running from the four corners of the base to each of the two poles of the W B (white-black) line, represent the variations of tint and shade. Thus, along the line from R to W lie the light reds and pinks; from R to B, the dark reds; from G to W, the light greens; from G to B, the dark greens, and so on. The lines running from the four corners and the four sides of the base to its center, the point at which it is pierced by the white-gray-black line, represent the varying degrees of saturation, or chroma. Thus, at the outer end of each of these lines we may imagine a 'pure' color, one with the least admixture of light; as we approach the center, the point of middle gray, the color becomes paler, grayish, washed out, till we reach the center, where it entirely disappears.

It was stated a moment ago that the vast multitude of visual sensations arise through the variations in hue or color-tone, in tint or brightness, and in saturation. It was also said that the number of distinguishable hues around the base of medium tint and maximal saturation is estimated to be one hundred and fifty. It has been stated, further, that the total number of visual color qualities is more than 30,000. Turning again to the pyramid, let us try to form an idea of the conditions of their occurrence. First, let us think of the variations in color quality due to variations in shade and tint, or brightness. Begin with the middle tint of any one of the principal colors, say blue, and work along the lines leading upward to bright white and downward to deep black, and we get a number of tints of blue in the one case, and shades in the other. The variations in tint and shade may also be worked out for the other principal colors, red, yellow, and green. Further, each one of one hundred and fifty imaginary lines, which we may suppose to pass on the surface of the pyramid from W to B, and through points on the edges of the base, representing the 150 intermediate hues referred to above, may be gone over in the same way, working out the shades and tints for each hue. It is clear that even if our task ended here we should have discovered a vast number of color qualities. But this is only a beginning. Suppose that we pare away, except at the two poles, the outer layer of the pyramid, which represents the colors of deepest saturation, then we should have the same sort of a task as at first, except that in the latter case we should be working with color-tones that are less saturated. By continuing paring along the planes of each new discernible difference of saturation and by working through for each color-tone the shades and tints of each new plane of saturation, we shall find the total number of distinguishable color qualities, 30,000, more or less.

**Color Mixture.** — If a beam of sunlight is passed through a glass prism, it breaks up into a band of colors — violet, indigo, blue, green, yellow, orange, and red—known as the spectral colors. Conversely, if, under certain conditions, rays of light corresponding to these various colors are passed through a prism they produce a beam of light like that which when dispersed forms the spectrum. Accordingly, white light is said to be formed by the union of all the spectral colors. The science of optics teaches, further, that a light sensation may be produced by the union of certain colors selected from the total number given in the spectrum. Thus, under proper conditions, a combination of the four colors, red, yellow, green and blue, will produce the sensation of light. Certain other interesting discoveries in this field are: (1) that every color has a complementary, which, if mixed with it in the proper proportions, produces a sensation of colorless light or brightness (gray). Two colors whose mixture produces gray are said to be 'complementary' colors. The following pairs of complementary colors may serve as examples:

Red and bluish green.
Orange and greenish blue.
Yellow and blue.
Yellowish green and violet.
Green and purple.

(2) The mixture of two colors which are not complementaries produces an intermediate color. Thus a mixture (in the proper proportions) of red and yellow gives orange; of red and blue, violet.

(3) Newton's law of color mixture, as formulated by Titchener, is as follows:

"If two colour mixtures arouse the same sensation of light or color, then a mixture of these mixtures will also arouse that sensation. If, for instance, the grey produced by a mixture of carmine and bluish green is the same as that produced by a mixture of red and verdigris, then this grey will also result from the mixture, in the original proportions, of all four colours."[1]

Figure 23 represents the colors of the spectrum, together with purple (which is produced by a mixture of red and violet) and their various relations. The unshaded sectors represent the four principal

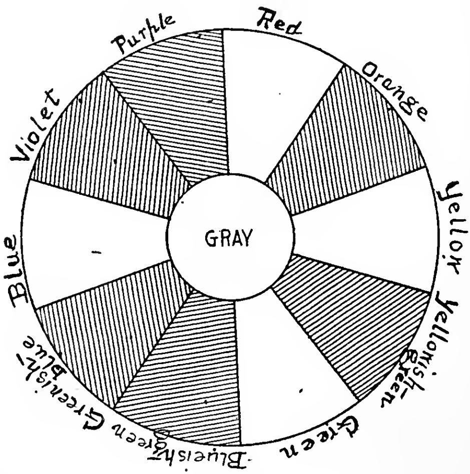


FIG. 23. The color circle. (After Angell; Psychology, Fig. 46.) The colors at the opposite ends of any diameter of the circle, when mixed, produce gray.

psychological colors; the shaded sectors represent intermediate colors.

**Visual After-Images.** — As a rule, the effects of a sensory stimulus last a little while after the stimulus ceases to act upon the sense organ. In the field of our visual sensations, where this phenomenon is

[1] *Text-Book of Psychology*, 1910, p. 69 f.

especially noticeable, the lingering effect occurs in one of two forms, namely, either as a positive or as a negative after-sensation, or 'after-image,' it is called by most psychologists. In the positive after-image, 'the relations of light and shade of the original object are preserved,' i. e., those parts of the original object which are light appear light, and those which are dark appear shaded, in the after-image. Further, the positive after-image of a colored object is usually of the same color as the object. After one's attention is once called to the matter, after-images of this kind seem to be of pretty frequent occurrence, or, at any rate, with a little care one may readily detect them. Thus, if one looks at a bright object, such as the sun or an electric light for an instant, then closes the eyes, an after-image of the sun or light persists for a time, and, in the experience of many observers, flits about in space with the movements of the eyes. A more impressive instance of the positive after-image may be obtained by carelessly looking from one's room for an instant, not more than a second, through a window, then closing and covering the eyes. Presently there appears an image of the window — dark frame, cross-pieces, if any, grayish spaces corresponding to the window-glass — all reduced somewhat in brightness, but in the same relations of brightness one to another as in the window itself. A most interesting feature of this experiment is the looming up in the image of objects which were not noted in the momentary glance, or which have never been noted, even though one may have looked through the same window in the same careless way scores of times. The things were there all the while, their images were impressed upon the retinæ, but hitherto we have not seen them.

In the negative after-image of a given object the relations of light and shade are reversed, i. e., what was light or bright in the object becomes dark or grayish in the image, and what was dark or shaded, becomes bright. Thus if one looks steadily at a fixed point of a window-pane for a period of thirty or forty seconds, then at a white or unfigured wall, presently an image of the window appears in which the light parts of the window appear dark, and the dark parts light. (At this point the student should perform the experiment with Figure 24). Moreover, in the negative after-image of a colored object the color is usually the complementary of the original. Thus, if one places a small piece (one inch square) of colored paper, say red or blue, on a sheet of white paper, and looks

Fig. 24. (By the courtesy of Harmegines & Howell, Printers, Chicago.) Directions for experiment at the bottom of this page.

Look steadily at the star under the eye in the figure above while you count slowly up to 25 or 30; then look at the center of a sheet of white paper and you will see, after a moment or so, the face of a well known American.

steadily at it for fifteen or twenty seconds, then looks away to some other part of the white sheet, one sees a patch of color of the same general shape and size as the original, but strikingly different in color — greenish if the original was red and yellowish if the original was blue. To repeat: the essential points to remember are, (1) that the general difference between positive and negative after-images is that in the former the relations of light and shade are the same as those of the original object and that the colors are usually the same; and (2) that in the negative after-image, the relations of light and shade are reversed, and the colors are usually the complementaries, or opposites, of those of the original object.

**Color Blindness.**[1] — It is well known that many persons are incapable of distinguishing between certain colors; they are more or less color-blind. This defect may exist in varying degrees from slight imperfection of the color-sense to total color blindness in which consciousness of colors is entirely lacking and the things of the external world are seen merely in varying shades of gray.

Students of color-blindness tell us that it is difficult, or even impossible, to make a satisfactory classification of these phenomena, and for the reason that 'hardly any two instances of color-blindness are precisely alike.' But, neglecting individual differences, color-blindness may be classified, first, as

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[1] The following paragraphs on Color Blindness are based on Howell's discussion of this topic. See Howell, *A Text-Book of Physiology*, 1909, p. 345 ff.

either total or partial. Total color-blindness, as has been remarked already, is insensitiveness to color, and obviously, it has no subdivisions. Partial color blindness, on the other hand, occurs in either of two forms — red-green or violet blindness — the former being by far the more frequent. Persons who are red-green blind distinguish in the spectrum only yellows and blues. "The red, orange, yellow, and green appear as yellow of different shades, the green-blue as gray, and the blue-violet and purple as blue. . . . . When the spectrum is examined by such persons a neutral gray band is seen at the junction of blue and green. . . . . . In red-blindness the most characteristic defect is a failure to see or to appreciate the green. This color is confused with the grays and with dull shades of red." The green-blind are also red-green blind; they confuse reds and greens, and in the spectrum are conscious of only two color qualities — namely, yellow and blue. . . . "Violet blindness," still following Howell, "seems to be so rare as a congenital and permanent condition that no very exact study of it has been made. In cases of acquired violet blindness resulting from pathological changes it is reported that the violet end of the spectrum is colorless and that a colorless band appears also in the yellow-green region of the spectrum."

STATISTICS: INHERITANCE.— Investigators differ as to the percentage of color-blindness in our modern communities; but the statistics leave no doubt that the defect is far more prevalent than is generally known. Perhaps it would be safe to say that, on the average, in a community consisting of four hundred males and four hundred females twelve of the former and two of the latter will be found to be color-blind.

Curiously the defect may be inherited; and, 'since females are less liable to be affected than males, it often happens that the daughters of a color-blind person, themselves with normal vision, have sons who inherit their grandfather's infirmity."[1]

**Practical Considerations.**—The practical importance of determining whether a given person's color vision is normal has been emphasized in recent years by the discovery that accidents by rail and at sea are due in some cases to the inability of engineers and pilots to distinguish the lights ordinarily used for signals. And it is now the general practice of the managers of railways and shipping companies to require tests for color-blindness of all their employes who are responsible for the interpretation of lights used in signaling. For example, the writer knows a skilled oculist who gives a large part of his time to testing for color vision defects the employes of a great railway corporation. School officials and teachers are also beginning to realize that color-blind pupils cannot engage profitably in certain school exercises, and that methods of teaching, suitable for the children whose vision is normal, are unsuitable for those who are color-blind.

**Tests for Color Blindness.**—Because of these practical considerations, a number of methods of testing for color-blindness have been proposed and used

[1] DONALDSON, *American Text-Book of Physiology*, vol. II, p. 339.

with varying success. One of the simplest and best — the Holmgren — is thus described by Howell:

"A number of skeins of wool are used and three test colors are chosen,—namely, (I) a pale pure green skein, which must not incline toward yellow green; (II) a medium purple (magenta) skein; and (III) a vivid red skein. The person under investigation is given skein I and is asked to select from the pile of assorted colored skeins those that have a similar color value. He is not to make an exact match, but to select those that appear to have the same color. Those who are red or green blind will see the test skein as a gray with some yellow or blue shade and will select, therefore, not only the green skeins, but the grays or grayish yellow and blue skeins. To ascertain whether the individual is red or green blind tests II and III may then be employed.

"With test II, medium purple, the red blind will select, in addition to other purples, only blues or violets; the green blind will select as 'confusion colors' only greens and grays.

"With test III, red, the red blind will select as confusion colors greens, grays, or browns less luminous than the test color, while the green blind will select greens, grays, or browns of a greater brightness than the test."

**The Color Zones of the Retina.** — Besides the two forms of abnormal color-blindness described in the preceding paragraphs, there are also certain forms which are normal, i. e., are phenomena of the activity of the normal eye. Thus if we think of the retina as being divided into three zones, we may then say that the outermost zone is defective in its reactions to all color impressions—objects seen with this part of the retina ordinarily appear as light or dark patches — that the middle or intermediate zone is

[1] Howell, *A Text-Book of Physiology*, 1909, 347 f.

blind to all colors except blues and yellows; and that the central zone or area alone furnishes all color qualities. (See Fig. 25). It should be remembered that the failure of a given object to arouse a color sensation does not mean necessarily that the object is not seen at all. We are all the while aware through sight of the presence of innumerable objects lying in the outskirts of the field of vision, of whose colors, at the moment, we know nothing. They are seen as light or dark or grey objects, and we can tell nothing definite about their colors without looking directly at them. This may be shown roughly by the following simple experiment:

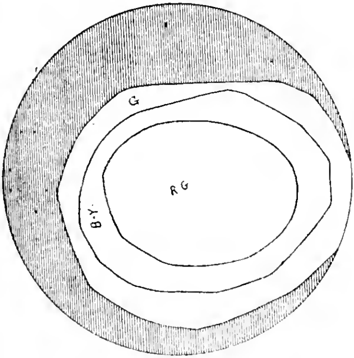


FIG. 25. Diagram representing the fields of vision for gray (G), blue, yellow (BY), red and green (RG), of right eye. Corresponding to these fields are the three retinal zones: (1) the central zone which is sensitive to all colors and brightnesses; (2) the intermediate zone in which only blues, yellows, and brightnesses can be seen; (3) the outermost zone over which all colored objects look gray.

As you sit at your study-table, stand a blue-covered book at the left end of the table-top, then place to the right of the blue-book, at a distance of twenty inches, a green-covered one; then look steadily at the center of the cover of the blue book and observe that you cannot tell the color of the book on the right. Of course you *know* that it is green, but you see it merely as a patch of dark, not as a green as you do when you look directly at it. "Again," to quote Seashore, "if we look steadily at one flower in a flower-bed and attempt, without movement of the eyes, to see the coloration of the whole bed, we observe that, outside of a certain narrow limit, the leaves do not look green; beyond a somewhat larger limit, no flowers are seen red, although the blue and yellow ones look brilliant; and in the outermost parts of the bed all flowers and leaves look gray." [1]

By way of caution, it should be said that the color zones of the retina, and the corresponding 'color fields', as they are called, vary greatly from individual to individual, and also with differences in the nature of the objects seen. Thus in regard to the individual differences, it is said that the distribution of the color elements in no two retinas is precisely the same; and Howell suggests[2] that since the color-fields of no two persons are precisely alike, it is possible that a test of the color-fields might be used for the identification of individuals, in the same way that 'thumb-prints' are now used for this purpose. In regard to the second ground of variation of the color fields it may be remarked in general that the larger, the brighter, the more saturated are the colors seen, the larger will be the color fields.

The interesting theory has been advanced that the existence of three retinal zones indicates that there have been three stages, or epochs, in the evolution of the organ of vision. During the first epoch an eye was developed which was sensitive only to differences of brightness; during a second epoch, cen-

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[1] *Elementary Experiments in Psychology*, 1908, 27 f.
[2] *Text-Book of Physiology*, p. 348.

tral elements of the retina became sensitive to yellows and blues, and gradually spread, during evolutionary ages, from the central region toward the periphery of the retina. During a third epoch, according to the theory, sensitiveness to reds and greens was developed in the central portion of the retina. Thus there have been developed the three color zones as they exist at present in the normal human eye. Some writers indulge in the curious speculation that in some future age all parts of the retina, excepting the blind spot, will be sensitive to all color impressions, and that the appearance of an eye possessing color zones, such as have been described above, will then be regarded as an atavistic phenomenon, reminiscent of the long past age to which we now belong.

## AUDITORY SENSATIONS.

**Nature of the Stimulus.**—Sènsations of sound are caused ordinarily by vibrations of the air. These air waves, or sound-waves, as they are also called, differ in respect to (1) wave-length or rapidity of vibration; (2) wave-amplitude, and (3) wave-form or composition. When the wave-length is small, when the distance from crest to crest is short, the vibration rate is rapid, and the number of waves in the one second is high. Conversely, increasing the distance from wave-crest to wave-crest lowers the rate of vibration, and so the number of waves in the one second. Difference in rate of vibration, or wave-number, is represented in Fig. 26 A. The rate of vibration represented by the dotted line is twice that represented by the unbroken line.

Wave-amplitude refers to the extent of the wave oscillation above and below an imaginary horizontal line. In Fig. 26 B the waves are the same in rate, but different in amplitude.

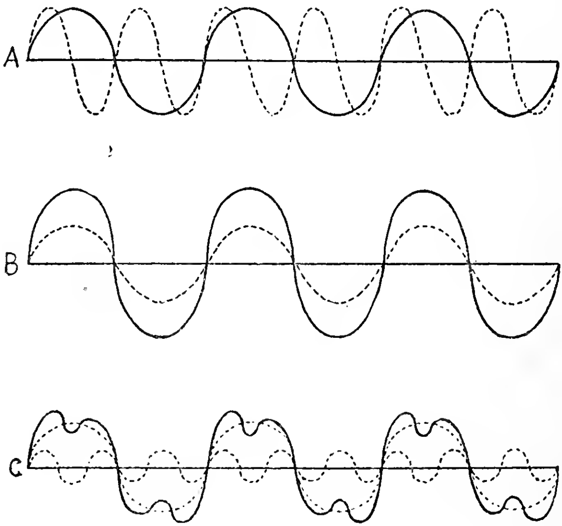


FIG. 26.

Air-waves may be simple and regular like those represented in Figs. A and B, or they may be complex, made up of two or more simple waves as shown in Fig. 26 C. The large, complex waves may be conceived of as composed of a number of smaller ones. Complex waves are often likened to the waves which pass along a rope when it is jerked up and down by a trembling hand. The smaller waves caused by the trembling enter into the larger movement and change it from a smooth to a wavy line.

**Classes of Auditory Sensations.** — There are two great classes of auditory sensations — tones and noises. They differ, according to Titchener, chiefly in the fact that tones "have a certain clarity and stability," whereas "noises . . . are dull and instable; if momentary, they are abrupt and harsh, if continued, they are rough and turbid." Sensations of tone may be experienced without accompanying noise; "but it is difficult to decide," says Titchener, "whether sensations of noise occur without accompanying tones."

Noises are distinguished by Titchener as "explosive" and "continuative." "For the former we have such words as crack, pop, snap; for the latter such words as hiss, sputter, rumble."

**Attributes of Tones.** — Tone sensations show five attributes: quality (pitch), volume, intensity, clearness and duration. Pitch refers to the position of a tone on a scale rising from the lowest, deepest tones to the highest ones. The pitch of a tone is determined by the length of the air-waves or the vibration rate of the sounding body which causes it. Short waves (high vibration rate, large wave-number), correspond to tones of high pitch; long waves (low vibration rate, small wave-number), correspond to tones of low pitch.

Authors differ somewhat as to the range of audible tones, i. e., the lowest and highest vibration rates which produce tones that can be heard. Titchener places twelve vibrations as the lowest and fifty thousand as the highest. In other words, exceptional ears can hear the extremely low tones produced by twelve vibrations per second, and the extremely high tones produced by fifty thousand vibrations per second. The same author teaches that, 'between these extremes the trained ear can distinguish some eleven thousand different tones', and that the tones of the musical scale range between 'the limits of about forty and four thousand vibrations in the one second'.

In the second place, tones differ in respect to size or volume. Some tones, like those of a great pipe-organ, are large, massive, space-filling; others, e. g., the peep of a newly hatched chick, or a high note of the violin, are small, sharp, pointed. Generally speaking, the deep tones seem voluminous, and very easily lead us to think of a wide-spread commotion, the tone-shocking of a large air-space, whereas the high tones seem small and concentrated, and we think they might easily be confined within small limits. It may be remarked that in the writer's experience the high tones seem more like fine lines shooting through space, than a commotion in a merely small, relatively stationary, spatial area.

Thirdly, tones differ in intensity, depending upon differences in the amplitude of the sound waves which cause them. Of two tones of the same pitch one may be weak or faint, the other, strong or loud.

Fourth, tones appear, in the conscious field, as either focal or marginal, or at some intermediate point.

Lastly, and obviously, a tone must have a certain duration, it must last a longer or shorter period of time.

**Classes of Tones.**—Besides the simple, or pure tones such as are produced from tuning-forks mounted on properly tuned resonators, text-books of psychology usually describe a number of tonal experiences which are dependent upon the various relations in which tonal sensations occur. Thus there are compound tones, difference tones, consonant and dissonant tones, and so on. The conditions of the occurrence of each of these classes mentioned will be described briefly.

**Compound Tones: Timbre.**—The sound waves which arouse sensations of tone are usually complex in the sense described above, (p. 98f) and the resulting tone is compound in that it is possible, after practice, to resolve it into a number of partial tones, the lowest of which is termed the fundamental, and the rest the upper partials, or over-tones. The fundamental tone depends upon the larger wave-movement of the sounding body, e. g., a piano wire or violin string; the partial tones depend upon the quivering movement which forms a part of the larger wave movement. The pitch of a compound tone is approximately that of its fundamental.

**Timbre.**—The overtones of notes of the same pitch, sounded on different musical instruments, e. g., a piano, a flute, an organ, differ in respect to their number and relative intensity. These differences give rise to differences of 'timbre.'

"Most of us", says Titchener, "lack the training, and some lack the ability, to resolve a compound tone into its simple components. Under these circumstances, the tone itself is heard as simple, but has upon it a certain colouring or timbre, which varies with the various instruments."

Harmonic Intervals: Beats.—Two tones of the same pitch, heard at the same time, fuse into a single tone of the same pitch, but of greater intensity. Two simultaneous tones, one of which depends upon a vibration rate exactly twice that of the other, the octave of the musical scale, tend to blend into a single tone. Tones which thus blend are said to be consonant or harmonious. Other ratios of vibration rate which produce consonant tones are: 3 : 2, 4 : 3, 5 : 3, or the fifth, fourth, the major sixth, and so on, in other words, the musical intervals of the musical scale.

If the pitch-number of one of two simultaneously sounding tones is slightly higher than that of the other, the resulting sensation 'shows rhythmical fluctuations of intensity'; 'the sound is heard now to grow louder and then to grow fainter or even to die away, but soon to revive again, and once more to fall away, thus rising and falling at regular intervals, the rhythmic change being either from sound to actual silence or from a louder sound to a fainter one." These rhythmical fluctuations of intensity are known as *beats*.

Difference Tones.—Under certain conditions two simultaneous tones are accompanied by other tones 'for which', says Stout, 'there is no assignable physical stimulus'. 'If', quoting Titchener, 'we term the upper generating tone $u$, and the lower $l$, we hear, in general, a third tone whose pitch-number is $u$-$l$. This is known as the first difference tone $D_1$. Under favorable circumstances, a single pair of tones will give rise to no less than five difference tones, whose pitch-numbers correspond to the successive differences between the pitch-numbers of the lowest tones present in the complex. Thus, let *u* be a tone of 1328 and *l* a tone of 1024 vs. ($c^3$). Then we have

$$
\begin{aligned}
D_1 &= & u - l &= 304 \\
D_2 &= l - D_1 &= 2l - u &= 720 \\
D_3 &= D_2 - D_1 &= 3l - 2u &= 416 \\
D_4 &= D_3 - D_1 &= 4l - 3u &= 112 \\
D_5 &= D_1 - D_4 &= 4u - 5l &= 192
\end{aligned}
$$

all of which may be rendered audible to the practised ear."

## SENSATIONS OF SMELL

**The Organ of Smell.**—We have seen on a preceding page (62) that the fibrils of the olfactory nerve terminate in the olfactory cells, the end-organs for the sense of smell. The organ of smell may be further described as a small patch of brownish-yellow mucous membrane in the extreme upper part of the nasal cavity. This patch, called the olfactory surface, contains two kinds of cells: the olfactory cells proper, set amongst the larger, supporting epithelial cells. The olfactory cells are described as spindle-shaped and as terminating at the external surface of the olfactory region in hair-like processes, or cilia. (Fig. 18, p. 62.)

**The Olfactory Stimulus.**— In order to act upon the organ of smell, a substance must exist in the form of gas or vapor. Even substances like cologne and ammonia, which, in the vaporous form, give strong odors, are inodorous in the fluid form; and arsenic,

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[1] *Text-Book of Psychology*, p. 106 f.

which is usually thought to be odorless, is intensely odorous when it is vaporized by heating. Needless to say, olfactory stimuli ordinarily reach the olfactory region in the act of inspiration. If we wish to examine carefully the quality of a given odor, or to get more pleasure from an agreeable one, we deflect the incoming air currents upwards by sniffing.

**Relations of Sensations of Smell to Other Sensations.** — Many olfactory stimuli are peculiar in that they usually arouse, besides characteristic smells, other sensations which are ordinarily confused with the former. Thus the sweet taste of inhaled chloroform, the pungency of pepper, the pain from a sniff of ammonia, the nausea caused by decaying animal matter, are not easily distinguished from the accompanying odors. So we have the common expressions, 'sweet smell,' 'pungent,' 'painful,' 'nauseous odors,' meaning, in strictness, the sweetness, pungency, and so on of the sensations which accompany the odors.

**Classification of Sensations of Smell.** — The classification of the sensations of smell given below is the one first proposed by the naturalist, Linnaeus, and afterwards modified by Zwaardemaker and Titchener.[1]

1. Ethereal or Fruit Odours. — All fruit and wine odours; the scents of the various ethers; the smell of beeswax.

2. Aromatic or Spice Odours. — All spicy smells: camphor, turpentine, cloves, ginger, pepper, bay leaves, cinna-

[1] *Text-Book of Psychology*, p. 117 f.

mon, caraway, anise, peppermint, lavender, bitter almonds, rosemary, sassafras; thyme, geranium, bergamot; rosewood, cedarwood, etc.

3. Fragrant or Flower Odours. — All flower scents; vanilla, tonka bean, tea, hay; gum benzoin, etc.

4. Ambrosiac or Musky Odours. — Musk, ambergris, sandalwood, patchouli.

5. Alliaceous or Leek Odours. — Onion, garlic, asafoetida; india-rubber, dried fish, chlorine, iodine.

6. Empyreumatic or Burned Odours. — Roasted coffee, toast, tobacco smoke, tar, burned horn, carbolic acid, naphthalene, benzine, creosote.

7. Hircine or Rank Odours. — Stale cheese, valerian, root and stem of barberry and black currant, lactic acid.

8. Virulent and Foul Odours. — Opium, laudinum, French marigold, fresh coriander seeds, squash bugs.

9. Nauseous Odours. — Carrion flowers, water from wilted flower stems, decaying animal matter.

This classification is confessedly unsatisfactory and provisional.

"It is unsatisfactory," says Titchener, "first, because there are many odours that cannot certainly be classed under any one of the nine headings; and, secondly, because the odours under certain headings (1 and 3, or 2 and 4) seem to be more nearly related than are particular odours under a single heading (2 or 6). Nevertheless it serves to give an idea of the immense range and variety of the olfactory qualities."

## SENSATIONS OF TASTE

**Organs of Taste.** — For a brief description of the organs of taste, see above page 61 and Fig. 17.

In reference to the distribution of the taste-bulbs, Ladd remarks that, "there is scarcely a spot from the lips to the stomach which some physiologist has not described as belonging to the organ of taste;" and while not all of these individual accounts have been corroborated, it is now generally agreed that the taste-bulbs are more widely distributed than merely on the surface of the tongue, as is popularly supposed. Besides occurring at the root of the tongue, where they are most numerous, and along its edges and at the top, taste-bulbs are found in certain other parts of the mouth and throat, e. g., on the soft palate, on the epiglottis, in the interior of the larnyx, and, in children, in the mucous membrane of the cheeks. Curiously, in adult life, a central area of varying size, on the upper surface of the tongue, is insensitive to taste stimuli.

**Classes and Relations of Taste Sensations.**— There are four elementary kinds of tastes: sour, sweet, salt, bitter. Every taste experience belongs to one of these classes, or is a compound of these elementary qualities. Our gustatory experience, however, seems to possess far greater variety and complexity than could possibly be obtained by the blending in every conceivable way of these four elementary tastes; and observation of the matter shows that what we commonly call tastes are, in fact, compounds of taste with other sensory qualities, chiefly odors, warmth, cold, and touch (pressure). Take, for instance, the so-called taste of coffee, which is composed, in fact, of a certain bitter taste, a characteristic odor, a sensation of cold or warmth, sensations of pressure and wetness, and, if one is unaccustomed to the beverage, an unpleasant puckery sensation. So of most of the 'tastes'; they are compounds of tastes with other sensations; and, as has been remarked in the section on Smell, many so-called tastes are really chiefly smells. This is true of the 'taste' of most meats and vegetables.

Illustrative of the results which are often obtained by mixing taste and smell stimuli, Titchener cites the pharmacist's directions

> "to take castor oil or cod-liver oil in claret or lemonade; the sour taste corrects the nauseating or hircine odour. Quinine, which tastes bitter and has no smell, is corrected by essence of orange peel, which has an aromatic smell and no taste. In all sorts of children's medicines, a disagreeable odour is offset by a sweet taste, or a disagreeable taste by some pleasant odour."

"The observations of every-day life," says Titchener, "which seem to show that certain tastes, e. g., sour and sweet, are antagonistic, and that certain others, e. g., bitter and salt, may exist side by side," are, for certain reasons, specified in his *Text-Book,* untrustworthy.[1]

## CUTANEOUS SENSATIONS

The skin contains four distinct kinds of sense-organs: those, namely, of pressure (contact), warmth, cold, and pain. Accordingly, what in everyday speech is spoken of as the 'sense of touch' really includes at least four kinds of sense-experience. Indeed, these distinctions are found in such expressions as, 'the stove is warm', 'the ice is cold,

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[1] *A Text-Book of Psychology,* § 36.

to touch,' 'their touch affrights me as a serpent's sting,' 'the lightest touch of thistles is painful'; but instead of referring each of these experiences to a separate sense-organ, they are thought popularly to be due to different ways in which the same organ, the skin surface, is affected. We shall consider briefly the cutaneous senses in the order just given.

**Sensations of Pressure.** — The end-organs of pressure are distributed over practically the whole extent of the skin. In those regions where hairs are found—that is, on nearly every part of the skin surface—hair bulbs are the organs of pressure; on the hairless regions, for instance on the palms of the hands and soles of the feet, the pressure organs are the corpuscles of Meissner, referred to above, p. 59. The 'pressure spots', as they are called, may be found by working over a given portion of skin surface with a finely pointed tooth-pick, or better, a horse-hair point which is made by attaching a bit of hair from the mane or tail of a horse to the end of a small stick, such as a match. When the pressure spots are touched lightly, one gets a sensation of mere contact, of 'something there'; if the pressure is increased the sensation presently becomes granular; 'it is', says Tichener, 'as if you were pressing upon a small hard seed imbedded in the substance of the skin'.

The distribution of the pressure spots differs in different parts of the skin surface. The number, per square centimeter, is said to vary from 8 or 9 on the upper arm to 300 on the scalp.

**Sensations of Temperature: the Cold and Warm Spots.**— Draw the point of a lead pencil lightly over the inner surface of the fore-arm and note that you get alternating sensations of pressure and flashes of cold. The flashes of cold seem, for the moment, to obscure the sensation of pressure, then pass away and one feels only the contact; or, if the pressure is very light, some of the areas yield no sensation whatever.

The warm spots may be found by slowly drawing the point of a nail (heated in hot, but not boiling water) over the wrist or the back of the hand. The warm spots are more difficult to find than the cold, 'partly because the warmed point quickly cools and partly because the sensations themselves are duller and less insistent than those of cold,' they do not force themselves to the focus of consciousness as do the flashes of cold of the preceding experiment.

The end-organs of temperature, like those of pressure, are found over the whole extent of the skin. Their distribution differs in different regions of the skin area; but there are, according to Titchener, about thirteen cold spots and two warm spots to the square centimeter.

Two results of the experimental study of the temperature senses are curious enough to warrant special mention. One is that if we touch a cold spot with a nail warmed to 45° C. (113° F.) no sensation results; but if the nail is warmer than 45° C., we get a sensation not of warmth, as one might expect, but of cold. No satisfactory explanation has been given of this 'paradoxical sensation of cold' as it is called. 'Paradoxical sensations of warmth,—sensations aroused at the warm spots by a very cold stimulus,—have never been observed in the normal subject.' The second is that heat or hotness is not, as is generally supposed, a high degree of warmth, but is a third kind of temperature experience, and results from the simultaneous stimulation of cold and warmth nerves by a stimulus above 45° C. The sensation of heat which is seemingly a simple and unanalysable experience may be analysed, under proper conditions, into the two component sensations—warmth and cold.

**Sensation of Pain.** — The sensation of pain, the disagreeableness or hurt which is caused by the intensive stimulation of a pain spot, must be carefully distinguished from the 'feeling' of pain, or unpleasantness. "Pain sensations are,' as Seashore remarks, 'nearly always unpleasant, but not all unpleasant experiences are painful. (Thus) it is exceedingly unpleasant to overturn one's cup of coffee at dinner, but it is not necessarily painful unless one happens to be scalded by the liquid." We must also distinguish the cutaneous sensations of pain, with which we are now concerned, from the pains which are derived from the tissues lying beneath the skin and which are usually referred to some definite internal organ, e. g., the stomach, or heart, or a nerve, as their seat.

Pains as sensations differ in respect to (1) intensity — they may vary from faint to the extremely intense; (2) duration — they may be momentary or prolonged, continuous or periodic; (3) extensity — they may be fine, sharp, cutting or spread out and dull. These variations in intensity, duration, and extensity, together with the combinations resulting from the blending of pain sensations with the sensations of temperature and pressure, account for the vast variety of pains described in common speech as stinging, cutting, burning, scratching, smarting, chafing pains, or as being dull or sharp, fine or massive. For instance, a stinging pain, according to Calkins, "is a complex experience of painfulness, of warmth and of a small extent of pressure;" a burning pain is composed of high degrees of both pain and heat; a cutting pain is a complex of painfulness and successive pressure sensations.

Besides the four kinds of cutaneous sensations already described, the skin seems to yield a number of seemingly elementary sensory experiences which are not included in the foregoing list. For instance, hardness, softness, roughness, smoothness, wetness, dryness, clamminess, oiliness, are popularly thought to be elementary touch experiences. They are, however, complexes due to fusions and variations among the cutaneous sensations, and to the blending of these latter with other sensations. They are described by Titchener as 'touch-blends', and will be referred to later (p. 113) under that heading.

## THE KINAESTHETIC SENSES.

The organs of the kinaesthetic senses are found in the muscles, tendons, joints, and in the semi-circular canals and vestibule of the internal ear. The corresponding kinaesthetic sensations are known as the musclar, tendinous, articular sensations, sensations of swimming or dizziness, and of lightness or pressure in the head.

Under a pressure stimulus of varying intensity the muscles yield sensations which Titchener describes as being, first, dull, diffuse, then dragging, sore, tired, achy. In general, the muscular sensations resemble sensations of pressure.

The tendinous sensations — which form the body of most of the ordinary sensations of strain, effort, exertion—originate chiefly in end-organs, called the spindles of Golgi, found in the tendons. (See Fig. 16 F, p. 58).

The articular sensations, as the name indicates, originate in the stimulation — ordinarily by movement at the joints — of sense-organs, distributed in the articular ligaments and in the synovial membranes lining the joints. These sensations are essential apparently to our perceptions of position and movement. For example, our knowledge of the position of an arm, or of a movement which it makes, is based, in part, upon the articular sensations connected therewith. Moreover, our perceptions of weight, as when we lift a heavy piece of furniture, and of resistance, as when we press with the hand against a swollen door, are both based upon the sensations originating in the articular surfaces. In lifting a heavy weight, the muscles involved jam the articular surfaces together and the sensation thus aroused is the essential feature of the experience. Again, it is easy to believe that the sensations which come from the articular surfaces form an essential feature in the perception of resistance, especially when one pushes against a resisting object with hand or foot.

The essential organs of the sensations of dizziness are three groups of hair-cells, containing nerve fibres, situated on the inner walls of the semi-circular canals. Whirling round and round, or moving the head rapidly in any direction, sets in motion the 'water' of the canals which brushes against the cells, giving rise to the sensation of swimming or of dizziness. Sensations sometimes of lightness in the head, sometimes of pressure or squeeze in the region of the ears, depend mainly upon changes in a structure called the otolith membrane, situated in the vestibule of the internal ear. "This consists," says Piersol, "of a gelatinous membrane in which are embedded numberless small crystalline bodies, the otoliths or ear-stones." A given position or movement of the head is accompanied by a given position or movement of the otoliths which, through the stimulation of the neighboring nerve fibrils, gives rise to the sensations just named.

Titchener's 'Touch-Blends'. A hard substance is one which offers resistance, which forces together articular surfaces, say of the hand or fingers; a soft substance is one which offers little or no resistance, which leaves the joint surfaces free. 'Hardness' and 'softness' denote differences in cutaneous and articular pressure sensations. The term 'wetness', of everyday speech, is used to refer to a variety of complex sensory experiences. Thus the hands feel 'wet' when taken from a bowl of water, a dish-cloth feels wet, our clothing is wet through, as in a drenching rain. Two sensory elements seem always to be present in the experience of wetness: a certain temperature different from the part of the body affected, and a certain pressure sensation. Under some conditions these two alone suffice to arouse the feeling of wetness; usually, however, they are accompanied by perceptions of a smooth, uniform movement over the skin surface, and of weight or resistance. Dryness is a complex of variations of the same sensations and perceptions. Roughness, when it relates to an object affecting the skin, means a broken, irregular movement and the 'variable stimulation of the pressure spots of the skin.' . . . . . . Smoothness means a free, easy, regular movement over the skin surface and the uniform stimulation of the cutaneous pressure spots. "Clamminess', says Titchener, 'is a mixture of cold and soft; the cold sensations and the pressure elements in the softness must be so distributed as to give the perception of moisture. . . . Oiliness is probably due to a certain combination of smoothness and resistance; movement seems to be necessary to its perception.'"[1]

**Organic Sensations.** — Certain sensations originating in the digestive, circulatory, respiratory, and genital organs are grouped under the general name, Organic Sensations. Among them may be named the sensations of hunger, repletion, thirst, nausea, the oppressiveness from breathing stuffy air, the sense of exhilaration from breathing fresh, clear air, characteristic sensations from the heart region in anxiety, fear, disappointment, or after great physical exertion.

Although it is true, as Titchener observes, that, as compared with our knowledge of the sensations of sight and hearing 'our knowledge of the organic sensations is scrappy in form and small in amount', enough is known to warrant the statement that most, if not all, of the latter are complex experiences. Thirst, for example, is described as a blending of warmth and pressure sensations; hunger consists

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[1] *A Text-Book of Psychology*, 171 f.

of pretty definitely localized aches and pressure sensations; and it may be said that the remainder of the organic sensations are probably analyzable into simpler sensations, chiefly those of pressure, warmth, cold, and pain.

The organic sensations, in addition to whatever of interest may attach to them in and for themselves, are especially interesting to the modern students of psychology because of the large part they play in the life of feeling, emotion, and what are loosely called our moods and temperaments. We shall speak of the part they play in these experiences in later sections.

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# CHAPTER V

## PERCEPTION

**Perception Defined.**—The briefest possible common-sense definition of perception is: 'Perception is the consciousness of particular material things present to sense.'[1] (James). Perception is thus marked off, on the one hand, from pure sensation which is the bare consciousness of a thing's qualities, and which in itself is never awareness of the existence of the 'thing'; and, on the other hand, from images, mental pictures of objects, the representation thereof, after they cease to be present to sense. Thus we agree to call the consciousness which the light of a bright moon may arouse in the mind of a week-old babe — Sensation; a grown person's consciousness of the moon as he gazes at it — Perception; and the visual picture which one may have of the moon after its disappearance from view — an Image.

Like many other distinctions which the description of our mental life involves, the ones just drawn between perceptions and sensations on the one hand and images on the other are somewhat artificial and arbitrary. In actual experience, sensations shade into perceptions, and perceptions into images, so that no sharp lines of distinction can be drawn, except by leaving out of account many border-land phenomena. And yet, there are certain easily discernible differences between perceptions and sensations and between

[1] By 'things' is meant not only what in everyday speech we designate as 'things'—a book, a tree, a star,—together with their properties and conditions, but also events and situations.

perceptions and images. The study of the former, to which we now turn, should also add to our knowledge of the nature of perception as a distinct form of consciousness. The differences and likenesses between perceptions and images will be described in the chapter on Mental Images. (p. 138ff.)

**Perception and Sensation Compared.** — We have said that pure sensations are bare consciousnesses of the qualities of objects, such as redness or sourness or coldness, without any accompanying thought of the objects themselves, or of the qualities as belonging to objects. Sensations are aroused by the action of external objects upon the sense-organs, but in themselves they are not a consciousness of such objects. The distinctive mark of a Perception, on the other hand, is that it is a consciousness of a thing which at the moment is present to sense; it is at least the consciousness of 'something there.' In sensation, the qualities of things — colors, tastes, coldnesses, for example — are experienced as bare colors, tastes, coldnesses, while in perception they are thought of as belonging to things outside the mind. To illustrate: if rays from an electric light chance to fall upon the eyes of a ten days' old babe they probably awaken only a light sensation. Three years later, rays from the same light falling upon the same eyes awaken a perception of the light, the consciousness of 'something-out-there' which the child calls 'light.' The difference between sensation and perception may also be expressed by saying that while both depend upon the excitation of sense-organs by external objects, only the latter carries within itself the consciousness of such objects. Perception always points, however indefinitely, toward something; sensation, on the contrary, never points to, never means anything; it simply *is*.

From another point of view, we may say that whereas sensations are simple, elementary processes, in the sense explained in Chapter III, perceptions are always complex and comprise a central sensory factor supplemented by other sensations, images, thoughts, which constitute the perception's meaning. For instance, your perception—'piano', when a piano note is struck in your hearing, is a complex and consists of tonal sensations supplemented by images and thoughts of the general appearance of the instrument, its size, location, weight, color, lustre, the thought, or feeling, of the words, 'piano tone', and so on. Sensations are simple, elementary; perceptions are complex and comprise a number of related sensory, imaginal, and thought factors.

**The Genesis of Perception.**— In the foregoing paragraphs we have indicated the general nature of perception, and also certain respects in which it differs from sensation. Let us turn next to the question of the origin and development of perception in individual experience. An illustration will aid us perhaps in understanding the nature of the latter question. Suppose that, as you sit in your room, a certain series of sounds from the street reaches your ears, and you say, 'a motor-cycle.' Now, if you inquire concerning the nature of your consciousness, your perception of the motor-cycle, you probably find a series of explosive noises, located more or less definitely; possibly a faint visual picture of a moving figure, possibly also more or less strongly marked organic sensations, and the thought — 'motor-cycle'. If you know the machine and its rider well, your consciousness will likely be richer, fuller of details; but it need not be; it may still be merely the indefinite localization of a recognized sound. If now we ask by what steps this and similar perceptions grow up, what are the conditions of their appearance as distinct forms of an individual's mental activity, then we must retrace the experiences which taught us that sound sensations in general originate in external stimuli, and that these particular sounds belong to motor-cycles. Stated otherwise the problem of the genesis of perception in individual experience is — by what steps does an infant get from the plane of pure sensation—where sensations mean nothing, where they awaken no thoughts of things, but are a series of bare flashes of consciousness — to the plane of perception where sensory impulses at once awaken images and thoughts of particular things? The key to the answer to this question is found in the simple law (which we may call the general law of the perceptual process) that any sensory experience which resembles a former one tends to arouse images and thoughts of the former's associates. The consciousnesses thus aroused may be images of one or more of a thing's sensory qualities, or they may be merely bare thoughts of the thing's name or location, or merely of 'something there'. Thus an odor from ripe apples may awaken in one's mind images of apples of a given color, a given form, size, hardness or mellowness, roughness or smoothness, and so on; or merely the naked vocable or the fleeting, inarticulate thought—'apples.' A corollary of the foregoing law is that the recurrence, in kind, of any sensory experience which has previously been a factor in the consciousness of any particular thing may serve as the vehicle of the thing's perception, may mean that thing. For example, a given sensory impression, either of color, or of odor, or of touch-blend, may mean — to one familiar with the fruit — 'orange'.

With these general principles of the perceptional process in mind, let us trace briefly the steps whereby a baby acquires the perception of a given object — for example, some toy. We may suppose that the toy is shown to the child, and that he experiences a series of sight sensations, say red, blue, and yellow. Suppose also that the child is allowed to handle the toy and that he gets, along with the visual sensations, certain experiences of touch, weight, resistance, smoothness, hardness, movement, possibly the odor of fresh paint, possibly also sound sensations — either those which the toy makes under manipulation or of its spoken name. Now, while looking at and handling the toy, these various sensory experiences — the sound which the toy makes when shaken, the sound of its spoken name, its appearance to the eye, the way it 'feels to touch' — become linked together, so that the recurrence, in kind, of one of these tends to revive images and thoughts of the others. Whenever such a revival actually occurs, we have a rudimentary form of the perceptional process. This, the stage at which a particular kind of sensory process awakens images or thoughts of sensory qualities formerly associated therewith, may be called the first stage of perception; we shall see presently that it is not the final one.

Observation of certain phenomena of the early stages of the infant's mental development strongly confirms the view that perception begins in some such way as that just described. To cite only one example: observers of the behavior of infants report that searching for the source of sounds appears first near the beginning of the third month. Thus, if one stands outside of the child's field of vision and makes a noise with a familiar toy, the child wriggles and turns about as if looking for the source of the sound. It seems likely that in instances of this sort certain visual pictures have become associated with particular auditory experiences, and that the recurrence of the latter revives, according to the law mentioned a little while ago, the former.

But perception which consists merely or mainly of the revived images of sensible qualities not at the moment present to sense is distinctly a first stage, a baby's way of perceiving. A higher stage is reached when the child's perceptions are of things localized in a given direction and in a given place in space. Thus one combination of light and color means — a horse in the street; another, a soaring eagle; one sound means — a barking dog across the way; another, children playing in the yard below; one odor means—frying bacon; another, the furnace is smoking, and so on for the whole round of our sensory impressions and the meanings which they acquire in the course of experience.

It may be observed in passing that in the course of normal development, children reach a plane which is characterized by pre-occupation with objects of sense. The child lives and has his being in a world of perceived things. He is absorbed in objects of the outer world, their names and physical properties, whence they come and their uses. The stage is pre-eminently one of sense-perception. In time the objects of sense lose somewhat of their charm; and the perceptions of the developed mind are usually nothing more than the bare thoughts of the perceived things. Thus, one hears a distant noise and thinks — 'railway-train-over-there', or glances out of the window at the falling snow-flakes and thinks —'it's snowing', or gets a given odor and thinks 'a cigar', and that is all. It is only rarely that our perception consists in anything more than the barest pulse of recognitive thought. We know the thing, and that is enough. We do not stop to image it or any of its properties; perhaps it gets named and located; but comparatively few perceptions of the adult mind include even the thought of the perceived thing's name.

Variations in Perceptional Stimuli. — Ordinarily our perception of a given thing — say a building, a vehicle, an article of food, clouds, a piece of ice, depends upon the recurrence of one of a small number of definite sensory experiences which have become, through custom, factors in our consciousness of that thing. Moreover, most of the perceptions of normal persons are aroused by either visual or auditory cues. Thus, the normal person's perceptions of buildings, trees, a clouded sun, usually depend upon given visual impressions; perceptions of street-cars and automobiles depend upon either definite auditory or visual stimuli. But it is also clear that any sensory experience may arouse the perception of any particular thing, provided that a similar experience has at some former time been a factor in our consciousness of the thing. For example, a sudden change in temperature may mean — 'clouded sun', a change in air currents — 'a building is there', a given odor may mean — 'mince pie', a given coldness or the touch-blends, hardness, smoothness, wetness, may mean 'ice'. To illustrate further, the sensory cue to the perception of a tree is usually a blend of light and color; but it may be a certain touch, or a certain noise, as when the wind rushes through branches and leaves; it may be an odor either from foliage or blossoms or fruit, it may be a sudden pleasant warmth of the atmosphere which one experiences most strikingly when driving on a cool summer's night and unexpectedly passes under a large tree by the roadside. Any one of these sensory impressions may serve to awaken the perception — 'tree.'

The sensory element, or aspect, of a perception may be likened to the words whereby we learn to designate familiar objects. At first, both are meaningless and both may, in the course of experience, acquire meanings, come to point to particular things. In much the same way that the word 'coal', seen or heard, comes to mean a certain kind of fuel, a certain sensation either of color or contact or taste or odor comes to mean 'orange'.

**Variations in Our Perceptions of Particular Things.** — We have just seen that although our perceptions of given things arise, ordinarily, from one or another of a small number of sensory impressions, they may, under given conditions, be aroused by any one of a great variety of such impressions. We may next remark that the nature and the number of the mental factors which are present in the perceptions of given things vary greatly from individual to individual and from time to time in the experience of the same individual. These variations depend upon differences in native endowment and previous experience, upon one's mental alertness at the moment, upon the dominant mood and the trend of one's consciousness, upon the nature of one's immediate interests or occupation. Thus the content of one's perceptions may be dominantly visual or auditory or motor (kinæsthetic), or it may consist of all sorts of combinations of visual, auditory, kinæsthetic, and other factors. For one person perceiving is chiefly seeing; for another, it is hearing; for another, 'feeling'. For example, the perception 'rooster crowing' (if aroused by an auditory stimulus alone) consists, for one mind, mainly of a given recognized but indefinitely localized sound; for another, it is a visual picture of varying clearness and distinctness of the fowl in the crowing attitude; for still a third, it consists chiefly of a complex of sound and strain sensations, the latter being due to the imitation of the crower's attitude.

It is evident that individual variations in the perceptions of given things depend largely upon differences in individual experience. One illustration will suffice. To the experienced sailor, a shimmering light on the distant sea means 'an iceberg,' while to the mere land-lubber it remains unobserved or is a mere shimmer 'out there'; it awakens no associates or definite thoughts of its relations to other things.

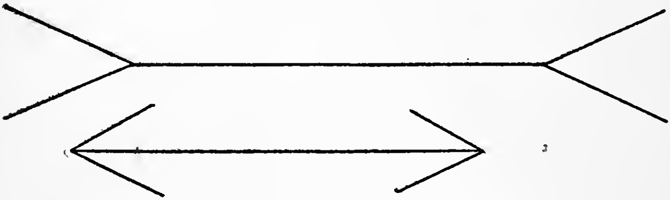
It is, perhaps, unnecessary to dwell upon the obvious fact that, other things equal, one's perceptional consciousness is richer, fuller of details, more accurate when one is mentally alert than when drowsy; nor upon the equally obvious differences among individuals in respect to the richness or poverty, clearness or dullness, distinctness or vagueness which characterize their perceptions. It is no less clear that mental trend, immediate interests and occupation determine largely whether one shall or shall not perceive the things which at a given moment are present to sense; and also, if they are perceived at all, what the character of the perception shall be. It is a commonplace that we are usually blind and deaf to most of the things about us; and, generally speaking, the perceptual consciousness of grown persons, except in respect to the things which immediately concern them, is vague and barren. Sensory impulses reach the cortex, the fleeting thought 'something there' shoots into the field of consciousness, but instantly fades away. What the 'something', of which we are dimly aware, is, where it is, of what stuff it consists, we do not know or care.

Illusions of Perception. — Every perception is a consciousness of something present to sense. It is a true, or correct, perception if the sensible qualities or behavior or relationships ascribed to a given thing are or may be confirmed by later observation or reflection; it is a false perception, or an illusion, if they cannot be so confirmed.

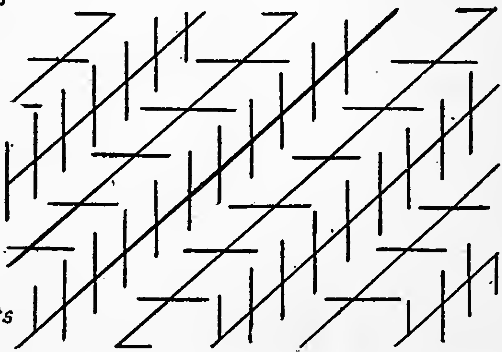
**Classes of Illusions.**—Illusions may be classified roughly as (1) those due mainly to the influence of the central, i. e., mental or cortical, processes; (2) those due chiefly to equivocal or deceptive processes in the sense-organs; (3) those dependent upon the joint or alternate action of the two foregoing principal causes. The situations in which these two sets of causes operate either separately or conjointly to give rise to false perceptions instead of correct ones may be illustrated briefly.

Illusions that depend chiefly upon the influence of the central factors are due very frequently to the fact that, at the moment of receiving a particular sensory impression, the mind, for some reason, 'is temporarily full,' to use James' phrase, of either images or thoughts of the object which is wrongly perceived. Numerous illustrations might be given of illusions due to one's mental trend, or 'cortical set'. The two following will suffice. Suppose that one walking by night in a strange wood sees ahead of him a darkish object bearing spots of light. The thing *is* a log holding cups of water which reflect the light of moon and stars. But if our imaginary traveller's mind is full of images and thoughts of wild beasts, he will not unlikely perceive the log and water as a beast of prey with gleaming eyes. Another familiar illustration of the influence of the dominant mental trend or imagery is — one's mistaking the ringing of a bicycle bell for that of the door-bell when one is expecting a visitor. In other cases, the illusion is due to the fact that a sensory impulse awakens its habitual associates which, in the given instance, are not or can not be verified by later observation. For example, a student of the 'Psychology of Suggestion' relates that when he sprayed the desks and floor of a school room with distilled water (which is perfectly odorless) from a Cologne bottle, several of the children present were sure that they smelled Cologne; spray from a Cologne bottle had in former experience given the odor of the perfume and so suggested it in the instance cited. On another occasion, the majority of a class in psychology read 'psychogaly' as 'psychology'; they caught a glimpse of the first part of the trick word or of its general form and length which revived its customary associate—'psychology'. Another illustration of illusion due to habit or association is the following: a few evenings ago the writer heard a distant noise which immediately suggested a faint picture of a drove of ducks and the thought — 'ducks quacking'; then he remembered that it was Hallowe'en and the sound was heard as one produced by a particular kind of noise-maker called a 'horse-fiddle.' Certain features of similar noises had on some former occasion been associated with 'quacking ducks', and upon their recurrence awakened that perception which, in the instance cited, happened to be false. Just why that particular noise meant just that particular thing and not some other one of a multitude of other possible things is a problem that belongs to a later chapter. It will suffice here to observe that, in the case cited, the present impression, through its resemblance to an earlier one, revived one of that earlier impression's associates, but a wrong one. The foregoing may serve as illustrations of illusions due to mental trend, cortical set, and habit.

Illusions of the second class are due chiefly, we have said, to either the equivocal or the misleading nature of the sensory processes involved rather than to the influence of mental habit, cortical trend, or expectancy. To this class belongs the illusion that an object comes nearer when, after looking at it with one eye, both eyes are used (James); the moon's



Müller-Lyer illusion



Zöllner lines
Fig. 27.

seeming nearer when viewed through an opera glass than when seen with the naked eye; the illusion that the rising moon is larger than the moon at full height; the illusion of two noses, when one crosses the second finger over the first and moves the tips of the crossed fingers to and fro across the bridge of the nose; the illusion which one gets of 'moving up stream' after gazing steadily for a time over the edge of a bridge at the flowing water below.

Pages 128, 129 contain a few of the better known illusion-figures which will serve as further examples

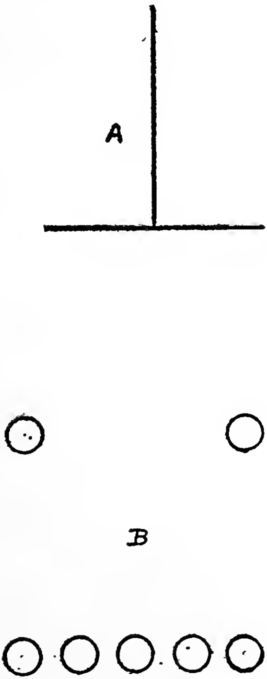
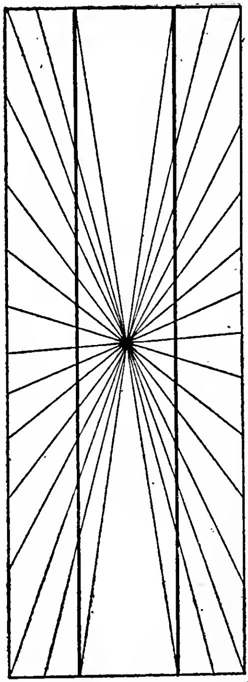


Fig. 28.



The Hering figure.

of false perceptions that are due chiefly to the illusory character of the sensory processes involved. In the Müller-Lyer figure the line bearing the feathered ends is judged to be longer than the one with the arrow-heads, although they are found to be of equal length when measured. In the Zöllner pattern the longer diagonal lines are parallel, though they seem to tip toward each other. In Figure 28 A the vertical and the horizontal line are of equal length, though the former looks longer. In Figure 28 B the distance between the centers of the outermost circles of the upper and lower lines is the same, yet it seems greater in the lower one. In the Hering figure the two inside vertical lines are parallel, yet they seem bent or bowed at the center.

The illusions which we have described in the immediately preceding paragraphs may be classed among the phenomena of the normal mental life. It remains to mention briefly certain illusions of the abnormal consciousness. Some of these belong to the 'dream life,' as when a sleeping person is touched with a pinpoint and dreams that he is being run through with a sword; others are characteristic of the hypnotic state, as when a hypnotized subject is shown a few scrawls on a sheet of paper and sees them as a photograph of a relative or as a copy of the Declaration of Independence; still others are of frequent occurrence in the insane, as when a patient hears the jingle of bells and imagines the martial music of an invading army. In these illusions a sensory stimulus is present, thus marking them off from the pure hallucin-

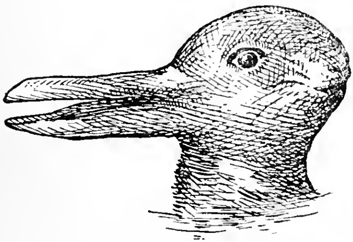


Fig. 29. (From Jastrow's 'Fact and Fable in Psychology', Fig. 19.)

ations, to be described presently; but its nature does not warrant the character, and particularly the exaggeration of the consciousness which it induces.

Equivocal Figures.—The influence of both mental trend, thoughts, imagery and sensory processes — now one, now the other, now both — in determining the nature of one's perceptions is strikingly shown by the variety of experiences one gets in looking at the 'equivocal figures,' (classed by some authors with the illusions) shown on pages 130, 131 and 132. Thus, whether one shall see figure 29 as a rabbit's or as a duck's head, figure 30 as superimposed triangles, or as a hexagon enclosed by six triangles, or as a diamond across which lies a concave polygon, depends chiefly on how one conceives of these different figures, i. e., upon one's present thoughts, images, and purpose. On the other hand, the fluctuations in one's perception of D (Thiery's prism), E (changing rings), F (Mach's book), Fig. 31, page 132, depend chiefly, but not wholly, upon muscular changes of adaptation in the eyes; while one's perception of figure G, as either a picture frame, or as the bottom of a dish, as the entrance to a tunnel, or as the frustum of a pyramid, or as a small square set in the midst of four

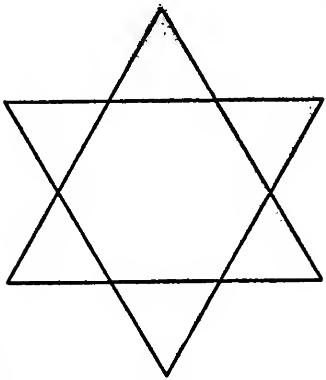


Fig. 30.

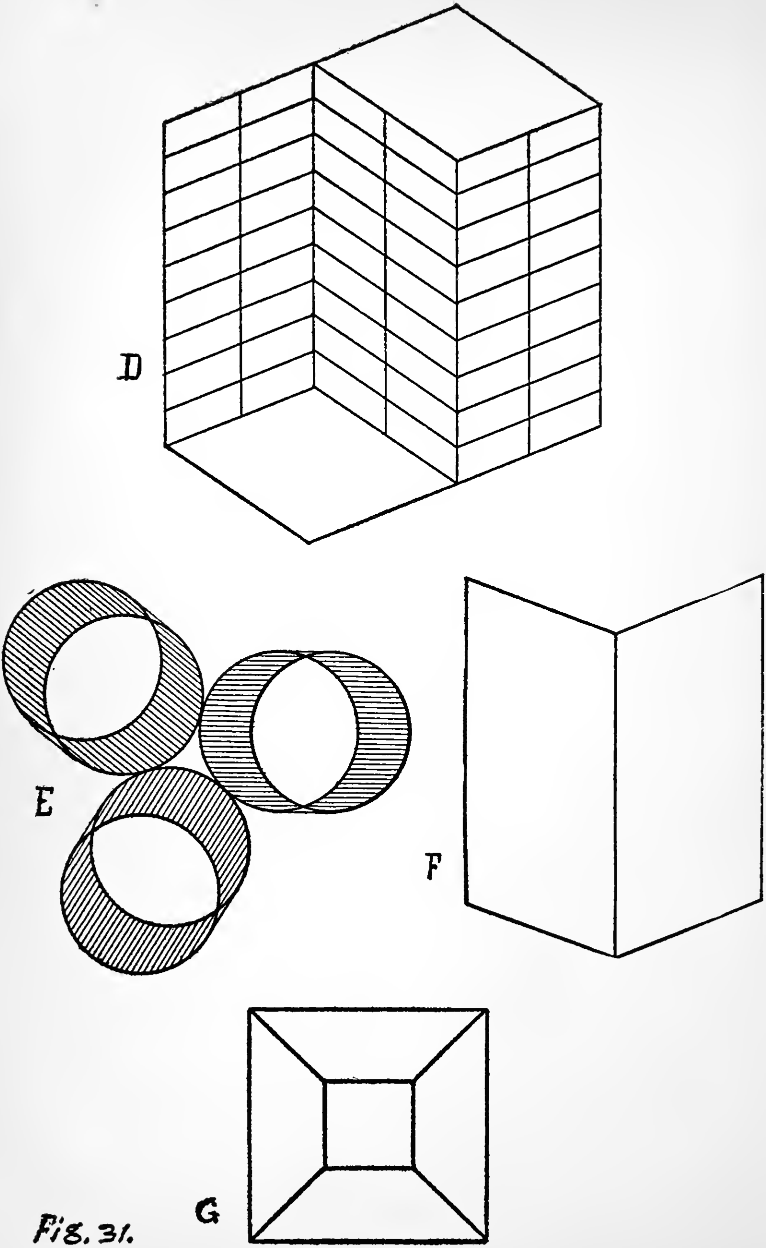



Fig. 31.

trapezoids, depends partly upon mental factors, thoughts, imagery, and partly upon eye changes — 'muscular changes of adaptation in the eye for near and far distances'.[1]

An interesting example of illusions that are dependent upon both mental habit and illusory processes in the sense-organs is that the larger of two objects, whose weight is the same, seems lighter. 'This illusion persists', says Titchener, 'in spite of our knowledge that the weights are equal'.

Hallucination.—As mental experiences, all perceptions, whether true or false, are alike in that they are consciousnesses of particular material things present to sense. The only difference is that the true perceptions are verifiable in a broader experience, whereas the false perceptions are not.

One group of false perceptions—called illusions—consists, as we have seen, of wrong interpretations of sensory impressions; thus a moving train is seen as if at rest, a stump of a tree is seen as a ghost, the rustle of leaves is heard as the stealthy approach of an enemy. A second group of false perceptions, called hallucinations, depend almost entirely upon changes in the sensory cortical centers or in the sense-organs themselves, i. e., they arise independently of the ordinary modes of sensory stimulation — by light waves, sound waves, odorous particles in the air, etc. Thus one 'sees' an animal enter the room, or 'hears' words spoken by a familiar voice,

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[1] For further description and explanation of illusion and equivocal figures, see Sanford, A Course in Experimental Psychology, 1898, Ch. VII; also Titchener, Experimental Psychology, Vol. I, pt. 1, § 44; pt. II, §§ 49, 50.

or 'feels' a hand laid on the shoulder, when in fact, in the first case, the room suffers no invasion, animal or other, and when, in the other two cases, no human being is within miles.

The centrally excited hallucinations, those dependent directly on changes in the cortical centers, are supposed to be due to the presence of irritants— such as alcohol, carbonic acid, or ether — in the blood which courses through the brain. The peripherally excited hallucinations are dependent indirectly upon physiological processes — some normal, some abnormal — within the sense-organs. Many of the hallucinations of the insane, of the drunkard in *delirium tremens,* of feverish patients, and of the dream consciousness, are believed to be due to this latter cause.

Those hallucinations which sometimes occur in minds which are otherwise healthy and normal, and which cannot, in the present state of knowledge concerning them, be assigned to any specific cause, are probably due to a temporary disturbance of the normal functioning of the cortical centers. This supposition is strengthened by the observation that they usually appear as features of mental states which are highly emotional in tone; their customary setting is some sort of mental agitation, usually of extreme anxiety or fear or anger or hope or a mixture of these and kindred emotions. For example, the case which James quotes from Gurney's Census of Hallucinations, of the girl who, during "a very painful discussion with an elderly person," wished very much for the opinion of a brother in regard to the matter, and turning "around saw him sitting at the further end of a center-table with his arms folded, . . . . wearing a sarcastic expression" . . . although he was not at the time near the place, is probably typical of the hallucinations of minds otherwise normal, in that it arose in a strongly marked emotional setting, namely, of distress, anger, longing, and so on. More impressive illustrations of hallucinations born of mental strain, of heat oppressed brains are found in the works of the novelists, poets and dramatists. Readers of Shakespeare, for example, will recall that he got strong dramatic effects in the portrayal of this phenomenon. Banquo's 'ghost', the dagger episode, Lady Macbeth's 'blood-stained hands' will readily occur as illustrations of the fact that emotional storm and stress is one fertile source of hallucinatory experiences.

The distinction just drawn between illusory and hallucinatory perceptions, namely, that the former involve the stimulation of sense-organs by objects external thereto, while the latter arise independently of such stimulation, is confessedly arbitrary. In actual experience, hallucinations and illusions, as regards both their nature and causes, shade into one another by imperceptible degrees.

See James, Prin. of Psych. II, p. 114 ff. for description of 'pseudo-hallucinations', and of certain forms of hallucination that seem to be peripherally excited. For theories in respect to the neural basis of hallucinations, see James II, 122-131. Pillsbury (Essentials of Psychology, p. 184 ff.) maintains that all hallucinatory experiences are probably traceable to a sensational basis.

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# CHAPTER VI

## MENTAL IMAGES

In the chapters on Sensation and Perception, we were concerned, mainly, with processes which arise only upon the stimulation of the sense-organs. Mental Images, which we shall now study, depend immediately upon changes in the cortical centers rather than upon sensory stimuli.

The term 'mental image' is used in psychology in three fairly distinct meanings. First, it is used to designate a special class of conscious processes in distinction from sensations, perceptions, thoughts, emotions, volitions, and so on. In this case, it means a centrally excited mental process which resembles in essential respects an earlier perception, i. e., an earlier consciousness of a particular material thing present to sense. For example, our images of the faces of our friends, of familiar stretches of landscape or of well known strains of music resemble, in some degree, our former perceptions of these objects. The term is also used in a narrower sense as the equivalent of 'memory-image' which differs from the broader term — mental image — by the fact that a peculiar sense of pastness and of ownership attaches to the experiences which we know by means of the former. In the third place, we use the term to mean an 'image of imagination', which may be described provisionally as a new and strange combination of perceptions and mental images, or of either of these, as when one images Cupid lightly poised in the crescent of a new moon. We shall be concerned in the present chapter with mental images in general. The distinctive features of this class of mental phenomena can be shown best, perhaps, by comparing them with perceptions and ideas — processes to which they are closely related.

**Perception and Image Compared.**—The comparison usually drawn between perceptions and images relates, primarily, to the sensory element, or aspect, of the original perception, on the one hand, and to the corresponding aspect of the image, on the other. From this point of view, it was said in the preceding paragraph that the image of a given thing resembles in essential respects a perception of the thing. For example, one's images of one's breakfast-table, or of the sound of a bell, or of the odor of coal-smoke, resemble more or less fully one's earlier perceptions of these objects. Again one's images of particular colors, tones, tastes, odors, temperatures, resemble the sensory *quality* of those particular colors, tones, and so on. The image of a red book or of the taste of a sour apple has the same quality of redness in the one case and sourness in the other as the original perceptual experience. In short, the image and the perception of a given thing are always qualitatively similar. Moreover, the image of the tones of a melody or of an object that possesses a varied color pattern reproduces, in some measure, the order and the relations of the perceived colors and tones. Imaging my breakfast-table or the notes of 'The Star-Spangled Banner', for example, means picturing not only the *qualities* of the several colors in the one case and tones in the other, but also imaging the colors in their respective places on the table and the tones in their proper order in the tune. In brief, the image and the perception of an object resemble one another in respect to both the qualities and (in the case of many objects) the order and arrangement of their several parts. So much with respect to the easily observed points of agreement between perceptions and images. Practically, their differences are no less evident; otherwise we should be puzzled all the while as to whether our days are being passed in a world of perceived things or in a world of merely imaged ones. Let us next note some of the ways in which perceptions and images differ.

We have said several times already that perception depends immediately upon the stimulation of a sense-organ, and that images arise independently of such stimulation, that in the former case the object is present to sense and that in the latter it is not. We have now to consider certain differences between perceptions and images which arise directly out of this primary difference in the conditions of their occurrence.

(a) Variations in our perceptions are controlled chiefly by variations in sensory stimulation, while variations in our images are relatively free from this influence; our images possess a certain freedom and independence which perceptions, owing to their necessary dependence upon sensory stimuli, lack.

(b) It is characteristic of many perceptions that they obtrude themselves, so to speak, into the stream of consciousness, they come unbidden and often with an aggressiveness which sweeps all before it. The image, on the other hand, has, in the normal mind, nothing about it which suggests the bold obtrusiveness of perceptions. This general difference, again, obviously depends upon the fundamental difference in the conditions of the appearance of the two processes.

This quality of 'aggressiveness', of 'striking the mind with force and liveliness', which perceptions sometimes possess, is, in Stout's opinion, the chief quality which marks them off from images; and broadly taken, it is no doubt an important ground of difference. But as reflection shows, it is not in itself a primary difference; it is dependent upon the more fundamental one (already mentioned several times), in the conditions of their occurrence. It may be observed incidentally that it is likely that in children, in highly imaginal minds, and in certain diseased minds, 'aggressiveness' is not so obviously a peculiar characteristic of their perceptional experiences as compared with their imaginal.

What we have described as the 'aggressiveness' of perceptions is closely akin to their 'inevitableness' and 'involuntariness' as described by Calkins. She writes: "I must see and touch just this pen . . . . I must hear this tune and must smell the odor of falling grass. I may wish that I held a silver pen [instead of one of celluloid], that I were smelling roses instead of hay; but I am bound down, in my perceiving, to precisely this experience. I am, in a word, directly conscious of myself as receptive. And this direct consciousness of my receptivity, prominent in my perception, is wanting to my imagination. In some sense, at least, my imaginings are under my control."[1]

(c) Another difference, which also results from the difference in the conditions of their occurrence, is that perceptions are more likely than images to be

[1] *A First Book of Psychology,* 1910, p. 11 f.

accompanied or followed by marked organic disturbances. The sight of a flash of lightning, or the sound of martial music, not infrequently produces in us unmistakable bodily commotion; but it is exceedingly rare that the image of either of these things occasions perceptible organic disturbance.

(d) Certain other differences between perceptions and images may be briefly noted. We may remark, first, that the perceptions of objects and the images thereof differ in that the former are more vivid than the latter. In this case, also, we mean that the sensory aspect, or factor, of the original perception is more vivid than the corresponding factor of the image. For instance, the sensory aspect of one's experience is usually more vivid when one is listening to the tones of a piano or is gazing at the starry heavens than when one is imaging these objects. Again, perceptions are usually clearer and more distinct than their corresponding images; they are also steadier, less fluctuating; they usually include more details and the order of the arrangement of these details is more accurate in the perception than in the image. Conversely, images as compared with perceptions are, as a rule, fainter, less vivid, hazier, more fluctuating, less complete in the matter of details, and less accurate as regards the order and arrangement of the latter.

If now it be asked how perceptions and images are distinguished in our ordinary waking consciousness, we must answer — not so much by their customary differences in vividness, distinctness, steadiness, and accuracy in the reproduction and ordering of details, or even by the quality of 'aggressiveness' possessed by the former, as by the sense of congruity, or harmony, with our other experiences of the moment, or the absence thereof, which each awakens. For example, the image of a puffing locomotive may rise in consciousness as one looks at the onward rush of a foot-ball team; but we know it is an image and not a real locomotive for the simple reason that its appearance at that moment is known to be incongruous with the total situation. Again, an image of a foot-ball scrimmage as one stands in the midst of engines and trains in a railway station is recognized as an image at once for a similar reason. It is not properly a feature of such surroundings. On the other hand, the flying colors, the cheers of spectators at the ball-game; the ringing of bells, the puffing of engines, the odor of smoke in the station, are immediately perceived as congruous with their respective total situations, and their perceptional character is readily admitted. In fact, this sense of congruity is so powerful in determining what processes shall be deemed perceptual and what imaginal, that images often fail to be recognized as such, if they are congruous with a perceptual situation, and with the dominant trend of consciousness. Instances of this sort were described in the paragraphs on Illusions (p. 126 ff.).

We have just seen that the sense of congruity is the practical test most frequently employed in distinguishing images from perceptions when our total experience is predominantly perceptional, as when watching a foot-ball game or the trains in a railway station. In like manner, when we are resting quietly in our room, day-dreaming, or rehearsing the numbers of a concert which we have recently attended, or repicturing the events of a recent trip, or merely retracing the day's happenings, the noise of a dog's barking outside our window, the ticking of the clock on the shelf, odors from the kitchen, the sight of the articles of furniture about us, do not get into the train of imagery for the simple reason that they do not belong there. They belong to a different group of mental experiences, to a different setting, and we are conscious of them, if at all, as features of their appropriate perceptional situations.

In order that the sense of congruity or of its lack shall arise in a given situation and shall operate so as to make us aware of what is perceptional and what imaginal in a given field of consciousness, there must be present a certain degree of self-consciousness, we must know at least dimly where we are and what we are doing. When this is lacking, as in little children, the line between perceptional and imaginal experiences also fades out or becomes shadowy. With this latter fact in mind we are often able to listen to a child's 'fairy-stories' without great alarm, and to reaffirm our belief that children are naturally truthful.

**Image and Idea Compared.**— The consciousness of a previously perceived object may arise in the form of either an image or an idea. In the former case, the earlier experience is copied, reproduced in some sort or degree. The sensational qualities, the particular colors or tones or tastes, or what not, of the original experience reappear, in some measure, in the image; further, the temporal order and the spatial arrangement of the components of the image resemble those of the earlier process. Thus, when one mentally pictures one's study, the colors of the various articles of furniture, the rug, decorations, pictures, table, rows of books, chairs, together with their customary positions in the room, are reproduced with more or less vividness and accuracy in the image. In brief, the distinctive character of an image is that it is primarily in some sort a copy of an earlier perceived object. On the other hand, the distinctive mark of an idea, in the present limited meaning of the term, is that it is a thought of, a mental nod toward, such an object. To ideate an object is, in this sense, to refer to it, to point toward it, to mean it. Now the idea of a given thing — object, event, or situation — may involve more or less of imagery of the thing; but it need not. Every case of thinking by means of symbols—signs, words, formulæ — is an illustration of this fact. When one says, for example, 'horses eat corn and hay', one expresses certain ideas, indicates certain things; but one need not image horses or corn or hay or the eating, though possibly one could if the circumstances required it. The thought of the words is sufficient to convey the meaning. The difference between imaging a thing and having ideas of or about it may be further illustrated by the familiar observation that one may think — 'the roar of a cannon is louder than a pistol shot' or 'the brightness of the moon exceeds that of the stars' without imaging the cannon's roar or the pistol shot or the brightness of moon and stars. The content of consciousness in such cases need not be distinctly imaginal at all; faint, fleeting images or sensations of the words are sufficient to carry the meaning. Moreover, we have ideas of things which we can in no sense image. For example, I may know that anger differs from fear, and yet be unable to image either of the emotions or their differences. Again, one may have ideas about, may think of, the odor of onions, but still be unable to image the odor; one may know, for instance, that it is different from that of locust blossoms, that it resembles garlic, that it is unpleasant to some persons, that certain superstitions cluster about its medicinal virtues, and so on. The imaginal consciousness — to repeat — resembles in some sort its object: the ideational consciousness is merely a thought reference to an object without any implication of its resemblance thereto.

**Type Images.** — In strictness, every perception or image of a particular thing, say a table or a dictionary or a study-lamp, differs in some slight degree from every other. At one time, one is most vividly conscious of one aspect of an object; at another, some other feature is most prominent. In my perception, say of my study-lamp, now one property, now another—its general form, size, weight, coloring, odor, steadiness or flicker of the flame, the sound it makes when handled—is most conspicuous. Yet out of all these various perceptions of the lamp — one may possibly say, despite them—some one image tends to precipitate and to get itself accredited as the characteristic image of the lamp. In like manner, the various perceptions of such objects as one's watch, one's pen-knife, text-books, pictures, articles of furniture, the house in which one lives, one's friends—tend to issue in definite imaginal forms which serve to designate these objects.

**Class Images.** — The perception of a number of individual objects, which so far resemble one another that we apply to them the same class-name, tends to produce a general or class image whereby we represent or refer to the group as a whole or to any one of its individual members. Thus, the image of a roundish figure of a given size and golden yellow in color means either oranges as a class or the individual members thereof. So also numerous perceptions of pine-apples, oak trees, violin tones, 'Ophelias', Merry-go-Rounds, polar bears, tend to give rise to class images which, while they are individual as mental experiences, serve to designate entire classes of objects and also the individuals belonging thereto. The type-images, of the preceding paragraph, are formed from numerous perceptions and images of the *same* objects; whereas, the class images are precipitates from numerous perceptions and images of *similar* objects.

Individual Differences in Mental Imagery. — "Until very recent years," James wrote in 1890, "it was supposed by all philosophers that there was a typical human mind which all individual minds were like, and that propositions of universal validity could be laid down about such faculties as 'the Imagination'. Lately, however, a mass of revelations have poured in, which make us see how false such a view is. There are imaginations, not 'the Imagination', and they must be studied in detail. . . . . . . . The first breaker of ground in this direction was Fechner, who, in 1860, published the results of a most careful comparison of his own optical after-images, with his optical memory-pictures, together with accounts by several other individuals of their optical memory-pictures. The result was to show a great personal diversity." "It would be interesting," Fechner remarked, "to work up the subject statistically," that is, to make a statistical study of individual differences in respect to imagery. This study was undertaken later by Galton, an English scientist, and the publication of his results in 1880 marks, James observes, "an era in descriptive Psychology."

Galton employed the now well-known 'questionaire method', which consists essentially in 'submitting a certain number of printed questions to a large number of persons', the questions in this case calling for data in regard to the mental imagery of the persons interrogated. Galton's questionaire is popularly known as the 'Breakfast-table' questionaire; but besides questions in regard to the clearness and brightness of the individual's image of the breakfast scene, the coloring of the china, the articles of food or "whatever may have been on the table", it contained inquiries in regard to the visual imagery of 'panoramic views', the location of things seen mentally, the command over visual images, images of the light and color of clouded skies, visual images of persons, of scenery, of numerals and dates, images aroused by printed descriptions of scenery, hallucinations, the use of visual imagery in mechanics, geometry, mental arithmetic, and chess-playing blindfold. It included also questions relating to the faintness or vividness of images of (a) sound, as 'of the ringing of a church bell, the hum of bees, the clinking of tea-spoons and saucers; (b) of smells, as of tar, a rose, tobacco; (c) of tastes, as of salt, lemon juice, chocolate; (d) of touch, as of velvet, sand, dough; (e) other sensations — heat, hunger, cold, thirst; also a question regarding the individual's aptitude for mentally recalling music, or for imagining it.' Hence, the fuller title which Galton employed — "Questions on Visualizing and other Allied Faculties."[1]

The subject of individual differences in mental imagery is one to which great theoretic interest naturally attaches. It has, besides, a number of practical bearings. For instance, students of the educative process hold that it is practically important that teachers shall know the capacity of their individual pupils for the various kinds of imagery. Accordingly, since Galton's time the question of imaginal types has received much attention, and many methods of determining individual capacities and variations in respect to imagery have been employed. "The principal result of the investigations is," as Titchener says, "the proof that type is far more variable and more complex than had at first been supposed." Still, certain minor results of considerable interest, mainly corroborative of the views of the earlier students in the field, have been definitely established, and we shall dwell upon them for a little while. These, so far as our present interest goes, may be summed up in the statement that individuals differ greatly in respect to, (1) the kind of mental imagery which is characteristic of, or predominant in, their remembering, imagining, and thinking; (2) the vividness, distinctness, clearness, stability, completeness, and accuracy of their characteristic images. We shall first indicate some of the more easily observed differences among individid-

[1] GALTON, *Inquiries into Human Faculty and its Development.*

uals in respect to their favorite or predominant kinds of imagery. These are usually described in text-books of psychology under such headings as "Imaginal Types," "Types of Mental Imagery," "Ideational Types." In later paragraphs we shall describe briefly certain differences among individuals in respect to the attributes of their characteristic images.

**Imaginal Types.** — The most conspicuous and the most interesting difference among individuals, as regards their imagery, is in respect to the sensory content, or basis, of the images which are most prominent in their trains of consciousness. Thus the images of one class of minds consist largely of visual material, they are mental pictures of things seen; for another class, they consist chiefly of sounds, of things heard; for still a third, images of things seen or heard or 'felt' arise with equal ease and frequency. Differences of this kind appear very clearly when one examines the answers which different persons give to such a list of questions as those first used by Galton; or the following, selected from Seashore's exercises:[1]

(1) Can you image the color of a green leaf? Can you image the brightness of a gray stone? the form of a tea-cup? Can you form a visual image of a moving express train? Can you hold fairly constant for ten seconds the image of the color of a rose?

(2) Can you image the sound of the hum of bees? Can you image the characteristic tone-quality of a violin? Can you repeat in auditory imagery the air of a familiar piece of music?

(3) Can you image, in motor terms, yourself clenching

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[1] *Elementary Experiments in Psychology*, 1908, p. 108 ff.

your fist? Do you get motor imagery when recalling words like Paderewski? Bubble? Can you form a motor image of the weight of a pound of butter?

(4) Can you form a tactual image of the pressure of velvet? of the flow of water against a finger?

(5) Can you image the odor of coffee? of an onion? of camphor?

(6) Can you image the taste of sugar? of quinine?

(7) Can you image the coldness of ice cream? the warmth of hot tea?

(8) Can you image a toothache or headache?

It is very likely, in other words, that the careful answering of these questions by a large number of persons, say a class of university students, would bring to light striking differences in imaginal type. Thus, some of the persons interrogated would answer the first list of questions, those pertaining to visual images, 'Yes', instantly and confidently, but would be hesitant and doubtful as to the other seven lists. These we should at once describe as 'visualizers.' Possibly others would show a like readiness and confidence in answering the second list of questions in the affirmative, but would show hesitancy and doubt as to the other lists: they can image sounds, but are unable to form unequivocal images of things seen, touched, or of movements, odors, tastes, temperatures or pains. These are known as the 'audiles'. A third class of persons would affirm that they constantly have vivid, life-like images of the stresses and strains which accompany the movement of the organs of speech when talking, or the movement of the limbs as in skating or in throwing a ball or in writing. These are called 'motiles', and their favorite images are the motor, or kinæsthetic.

"It has been asserted', says Angell, 'that we have no genuine motor, or kinaesthetic, images, [verbal or other] because every attempt to think of a movement results in our actually making the movement in a rudimentary way; so that we get a kinaesthetic *sensation* instead of a kinaesthetic *image*. There can be no doubt that this is often the case; e. g., the effort [to image the 'feel' of the word 'college'] will by most persons be found to be accompanied by definite sensations in the tongue and throat . . . . . Meantime, there seems to be no reason in the nature of the case why we may not have kinaesthetic images in a form definitely distinguishable from the kinaesthetic sensations to which they may lead."[1] Titchener, in reference to the same point, says, briefly, "kinaesthetic images are extremely difficult to distinguish from kinaesthetic sensations. The difference, in the writer's experience, is largely a matter of complexity: the mental nod which gives assent to an argument is more schematic, involves fewer muscles and involves them less solidly than an actual nod".[2]

The answers to the questions on p. 149 f. would also reveal the fact that a large majority of the persons questioned have good imagery in a number of perceptual (sensory) fields, particularly visual and auditory, and possibly motor and tactual. Their imagery is said to be of the 'mixed' type.

"When a mind is of this constitution", says Titchener, "an operatic performance (for example) is remembered [imaged] in all three ways, as something *seen*, as something *heard*, and as something '*felt*': stage and performers are visible once more, voice and orchestra are heard again, and the ease or difficulty with which the singers reached their high and low notes is sympathetically revived. . . . . . But an equal balance of tendencies is rare: even when a mind is to be classed as 'mixed' in type, experiment generally shows that some one side of it (the eye-side, ear-side, etc.) is more strongly developed than the others."[3]

[1] ANGELL, Psychology, 1908, p. 199 f. [2] TITCHENER, *A Text-Book of Psychology,* 1910, p. 199 f. [3] *A Primer of Psychology,* 1907, p. 125 f.

Finally, the answers would indicate, what is the fact, that the tactual, olfactory, gustatory, thermal, and pain images of question groups four to eight (Seashore's list) are comparatively infrequent, and that the number of persons who experience any of them is relatively small.

The student may have observed that so far our study in this section has pertained mainly to the imagery of concrete objects and their attributes. We have now to speak briefly of —

**Symbol Imagery.** — The student of the pure sciences — mathematics, astronomy, physics, for example — is required to think about the various phases of his subject by means of symbols appropriate thereto. His memory of the facts and laws of his science consists in large measure of a store of signs, symbols and formulæ; and his increasing proficiency consists partly in increasing facility in manipulating the symbols of his particular field of study. Moreover, it is frequently remarked that the highest success in the pursuit of the abstract sciences requires that the ordinary forms of imagery shall be subordinated to practice in marshalling the symbols of these disciplines, that a stream of concrete imagery is a hindrance rather than a help. One of the 'notable results' of Galton's investigation was that 'scientific men, as a class, have feeble powers of visual representation', from which Galton concludes that 'an over-ready perception of sharp mental pictures is antagonistic to the acquirement of habits of highly generalized and abstract thought.'

It is clear, however, that comparatively few persons employ in their remembering, imagining, thinking, planning, the special forms of symbolic imagery, such as are employed by the man of science. The most common form is the verbal, which, in Stout's opinion, 'plays a leading part in the mental life of most of us'. In some of us, he writes, 'such verbal images are almost exclusively used.' To the same effect Calkins says, "Contrasted with all these classes of concrete imagination [of panoramas, dinner-parties, concerts, etc.] are the verbal types, which are far more prevalent than any one, save the psychologist, realizes. In the experience of many people, these altogether crowd out concrete imaginings." At all events, we are well within the bounds when we say that the imagery of educated adults consists to a considerable extent of word images. Thus, in order to think of trees and their properties, it is sufficient, ordinarily, to have some sort of image of the descriptive words we use. We know that trees are leaved in summer and bare in winter; but in order to know this, we do not need to picture either their summer leafiness or their winter barrenness. We know that leaves rustle in the wind and that the bark of oaks is rough, but we do not need to image the rustling or 'feel' the roughness. Again, when you recall the persons whom you have met or the places you have visited, in the course of a day, it is sufficient to recall their names, though doubtless, for most of us, there is an accompaniment of concrete imagery, images of the persons' appearance, dress, gesticulation, voices, or of the size, form, contents, decorations of the buildings, offices, rooms, shops that were visited. In like manner, when we plan some future action, say a visit to a friend's house, we employ words to outline our plan rather than imagery of the streets and roads we intend to follow, or of our friend's house, or of his greeting, or of the persons we shall meet on our arrival. In short, our ordinary daily thinking, remembering, planning, is made up in large part of the images of words that suffice to designate our subjects of thought, the things with which, for the time being, we are concerned.

In reference to the advantages of words over concrete imagery as mental tools, James writes, "In fact, we may suspect them [words] to be for most purposes better than terms with a rich, imaginative coloring. The scheme of relationship and the conclusion being the essential things in thinking, that kind of mind-stuff which is handiest will be the best for the purpose. Now words, uttered or unexpressed, are the handiest mental elements that we have".[1]

The declaration that words constitute the best, the most convenient, instruments of thinking will raise doubts in the minds of those who have not given the matter careful consideration. Indeed, 'thinking' for most persons consists mainly of trains of concrete imagery; their thoughts would be pale and sparse if they were bereft of these. Nevertheless Galton and James are right in maintaining that, for purposes of abstract thinking, vivid concrete imagery is a hindrance; bare symbols are its best instruments.

**The Kinds of Verbal Imagery.** — We have seen in the preceding paragraphs that as regards their predominant forms of imagery, individuals may be

[1] Principles of Psychology, I, p. 266.

classified broadly as visuals, audiles, motiles, and mixed. Now the same classification holds in reference to the characteristic modes of imaging words. Thus the verbal imagery of one class of persons is predominantly visual; of another, it is chiefly auditory; of a third, kinæsthetic; while that of a fourth class of persons is described as 'mixed'.

**Visual.** — It requires only ordinary powers of verbal visualization to image a few words or sentences or even a short paragraph. If, however, one is highly gifted in this respect, whole pages of printed or written matter may, on occasion, unroll before the mind's eye. Galton, in the report already quoted, says: "I have many cases of persons mentally reading off scores when playing the piano-forte, or manuscript when they are making speeches. One statesman has assured me that a certain hesitation in utterance which he has at times is due to his being plagued by the image of his manuscript speech with its original erasures and corrections. . . . . . Some few persons see mentally in print every word that is uttered; they attend to the visual equivalent and not to the sound of the words."[1] The writer once knew a student who could 'read off' an entire *Act* of *Julius Caesar* as well as if the book which he had used in memorizing the play lay open before him.

**Auditory.**— One may also imagine words as heard. The words imaged may be those spoken by oneself

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[1] GALTON, *Inquiries into Human Faculty and its Development.*

or by others, they may be the words of a conversation to which one has listened, or the questions and answers of attorney and witness in a court-room, or the words spoken by actors, with characteristic modulation, in reading their lines in a play. Calkins observes that, "Such masters of musical verse as Sophokles, Tennyson, and Swinburne must have auditory verbal imagery."

Kinaesthetic. — "Most persons," says James, "on being asked in what sort of terms they imagine words, will say, 'in terms of hearing.' It is not until their attention is expressly drawn to the point that they find it difficult to say whether auditory images or motor images connected with the organs of articulation predominate. A good way of bringing the difficulty to consciousness is that proposed by Stricker, [whose verbal imagery consisted, according to his own account, exclusively of articulatory images]: Partly open your mouth and then imagine any word with labials or dentals in it, such as 'bubble', 'toddle', (puddle). Is your image under these conditions distinct? To most people the image is at first 'thick', as the sound of the word would be if they tried to pronounce it with the lips parted. Many can never imagine the words clearly with the mouth open; others succeed after a few preliminary trials."[1] Experiments of this sort show that in our verbal imagery the motor, or kinæs-

[1] James here refers, doubtless, to the motor images of words, since the open mouth is not a hindrance to the formation of visual or auditory verbal images, at any rate not in the present writer's experience.

thetic, factor plays an important, though usually unobserved part.[1]

**Mixed.**— A person whose verbal imagery is of the mixed type is able either to see or hear or 'feel' words in imagination as inclination prompts or occasion requires; but, as in the case of concrete imagery, some one form of verbal imagery usually predominates in the individual experience.

One general observation concerning the verbal imaginal types seems warranted, namely, that there is a stronger tendency to the concurrence, in individual experience, of two or more forms of verbal imagery than there is in the imagery of concrete objects or situations. Thus one's general imaginal type may be unmistakably visual, while one's images of words may readily occur in any one of the three forms already described. This is probably due to the fact that we are constantly experiencing words in varied ways; we are all the while reading or hearing or speaking or writing words, and it is but natural that our imagery of them should reflect, in some measure, our immediate, everyday experience with them.

**The Attributes of Characteristic Images Differ.** — In the immediately preceding sections we have been studying the ways in which individuals differ in respect to their dominant or favorite kinds of imagery. It remains to make a little clearer, than has been done hitherto, that individuals differ in

[1] Titchener thinks it improbable that in verbal imagery the auditory-kinæsthetic elements occur separately, 'although the emphasis may be preponderantly upon the one or the other.'

reference to the vividness, distinctness, clearness, and so on, of their characteristic images.

**Vividness.**— Galton, in his pioneer work, was concerned chiefly with the variations in the 'vividness' of the imagery of different persons, although he did not sharply distinguish this attribute from certain others. That this was his chief concern is indicated by the fact that the great majority of his 'Questions on Visualizing and other allied Faculties' were in reference to this property, and also by his arrangement of the replies to the questions pertaining to the visualization of the breakfast table in a scale of nine degrees of 'vividness'. Moreover, excepting kind, or quality, most of the studies of individual variations in imagery that have been made subsequently have related, mainly, to variations in vividness. Such questions as — Can you image the color of a yellow ribbon? the tone-quality of a given musical instrument? the pressure of velvet? usually mean: Are your images of these things vivid, lifelike? Seashore's chapter on "Mental Images" likewise reflects the dominant interest. In it he directs the student to fix clearly in mind the following scale in testing 'the capacity for vividness of imagery:'

0. No imagery at all.
1. Very faint.
2. Faint.
3. Fairly vivid.
4. Vivid.
5. Very vivid.
6. As vivid as in perception.

It is clear, however, as Seashore says, that "such factors [attributes] as vividness, stability, and integrity of the image do not necessarily vary together. An image may be very vivid, but flitting; it may be complete, but faint." Accordingly, a complete study of an individual's imagery would include, besides the enumeration of its several kinds, the careful discrimination of the latter's attributes, and their gradation according to some such scale as that employed by Galton or Seashore in studying vividness.

**Distinctness.** — The following may serve as examples of questions designed to draw special attention to the attribute of *distinctness*: Is your image of the tone-quality of a banjo perfectly distinct from that of a guitar? Do you tend to confuse the visual images of one face with that of another which resembles the first? Is your image of the smoothness to 'touch' of silk clearly different from your image of the smoothness of glass? Again, do you image distinctly the several parts or features of a photograph? or of a wall-paper pattern? or of a strain of music? or the taste ingredients of an article of food?

**Stability.** — Individuals differ also as regards the stability of their images. Some observers report that their characteristic images are stable, enduring, easily controlled; others, that theirs are transient, fluctuating, capricious.

**Completeness and Accuracy.** — If an image represents all the separate items of an original experience, it is said to be complete; if it does not represent all these separate items, it is incomplete. *Accuracy* refers to the fidelity with which an image copies a sensory or perceptual experience, to the absence of foreign elements in the 'structure of the image'. Needless to say, individuals differ in respect to the degree to which their images approach completeness and accuracy.

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# CHAPTER VII

## ATTENTION

**The Nature of Attention.** — Attention, perhaps more than any other topic in the whole field of psychology, is overrun with metaphors. We read of attention that wanders, flits hither and thither, or — lingers, pauses, hovers over its object; of attention that is drawn, lured, commanded, attracted, fascinated, captured, or — is repelled, diverted, distracted, freed. Attention is often described as concentrated, focused, or as scattered, diffused, spread-out, dispersed. Again, attention selects and seizes objects and lets them go again. In still other instances, it is directed toward or aimed at given objects which it illuminates. In popular speech it is also either weak or powerful, waking or slumbering, continuous or intermittent, prolonged or transitory, spasmodic or regular, alert or sluggish, and so on. It would be easy to select from the current psychological literature several such pages illustrating the figurative terms in which our thinking concerning attention is cast; the foregoing examples will suffice.

Now these and similar everyday expressions describe roughly certain facts of our mental life; otherwise they would not have gained such widespread acceptance. Moreover, it must be admitted at once that it is well-nigh impossible to speak of 'attention' at all, even in a scientific treatment of the topic, without employing them. And yet, for certain reasons which will be stated in later paragraphs (p. 181 ff.), psychology must set aside the figurative accounts, and ask what, in fact, attention is. When we do this, and when we adhere closely to the work of describing consciousness, and ask ourselves what general fact or characteristic of our mental life is named by the term attention, we answer — the fact of mental clearness. Attention is a general or class name for all clear consciousnesses. Whence it follows that the term, when used to designate a particular fact of consciousness, means a clear consciousness; a case of attention is a case of mental clearness.

The term 'attention' implies that a typical 'field' of consciousness consists of a central, relatively clear, area and an outlying, obscure area. In this case, 'attention' when used in reference to a given consciousness, means that it is focal, is in the center of the field.

It may be remarked that 'attention' is often used synonymously with 'mental activity', especially when the activity is conceived to be of an intensive sort. For instance, every case of intensive, restricted perceptional activity is a case of 'attention'. Thus, to 'attend to' the features of a drawing or a landscape, or to the separate voices in a chorus, is to 'look' carefully, intently, in the one case, and listen, in the other. Thinking and imagining, as forms of mental activity, are also cases of attention. Thus, to compare, to analyze, to weigh, to think about, two possible courses of action is to 'attend' to them. Every case of mental activity is, from this point of view, a case of attention. Observe next that it is not difficult to translate 'attention is mental activity' into 'attention is mental clearness', since one's meaning is the same whether one says, 'I am attending to the object' or 'my consciousness of the object is central, focal, clear.'

**The Conditions of Attention.** — By the 'conditions' of attention, or mental clearness, we shall mean the circumstances which favor the appearance of clear consciousnesses. Thus we may ask what circumstances favor clear perceptions of present objects, their properties and conditions, on the one hand, or clear images of past or future events, on the other. Or, from a slightly different point of view, we may inquire why, at a given moment in individual experience, one conscious process, rather than any other possible one, should occupy the center of the conscious field, the area of greatest clearness. It is evident that a complete answer to the latter question involves, besides an enumeration of the primary conditions of attention, also a statement of their inter-relations.

It is customary to distinguish broadly two classes of conditions of attention: the objective, or external, and the subjective, or internal. The term objective, or external, refers to the circumstances outside the stream of consciousness which favor attention; the term subjective, or internal, refers to those characteristics of the individual's present or past mental life which favor attention.

It should be remembered that when a given condition is said to favor attention the statement holds unless some other condition or conditions arise to counteract the influence of the first.

**The Objective Conditions of Attention.** — Most conspicuous among the objective conditions of attention are certain properties of sensory stimuli. Other things equal, a stimulus that is intense or prolonged or novel or frequently repeated or sudden in appearance or that changes in character, in size, in position, or in intensity, is likely to 'attract' attention, or, in our terms, to excite a clear consciousness. Thus, bright lights, loud sounds, strong odors, smart blows, are said to force themselves upon our attention. The consciousness which they arouse immediately becomes focal, clear. — The prolongation of the locomotive's whistling at crossings, the continual clatter of the fire-engine as it rushes along the street, the alarm clock set to ring for sixty seconds, are practical applications of the observation that prolonged stimuli excite attention. — Novelties of all kinds are notoriously attractive. Other things equal, novel sights and sounds, strange objects, new experiences easily 'catch' the attention. The notice which a stranger, or a new kind of vehicle, or even a new dog, in the community attracts are familiar instances of the influence of novelty. — Impressions frequently repeated, even though they lack other exciting qualities, are likely to arrest attention. Witness the results that the persevering advertiser obtains from comparatively stupid advertisements; witness also the diligence which the aspirant to political honors shows in keeping his name before the public. — Suddenness in the appearance of sensory impressions, if unexpected, like a flash of light in the darkness, or the sharp crackling of one's study-fire, or a sudden call from an unexpected quarter, is one of the most familiar of their inherently exciting qualities.

Objects that show changes are likely to catch attention. These changes may be either in the nature or size or position of the object, or in the intensity of the impression which it arouses. For example, a blue signal replaced by a red one attracts the attention of the pilot or engine man; the small boy observes at once any marked variations in the size of his daily allowance of favorite foods; and the fact that moving objects attract attention is too well known to require illustration. Change in the intensity of a previously unobserved sensory stimulus, whether visual, auditory, olfactory, or what not, particularly if sudden, tends to draw attention to the exciting object.

Two other classes of changes should be mentioned in this connection. (1) It is well known that we are unobservant of the permanent, unchanging features of our daily surroundings. The articles of furniture in our homes, the buildings and trees along the streets that we travel over daily, the noise of street traffic, the familiar voices of people talking, the puffing of distant locomotives or the rumble of trains drawn thereby, even pains that are with us constantly, all cease in time to attract attention. But changes in our customary surroundings, for example, a rearrangement of the furniture or of the decorations of our study, are noticed at once. And the obtrusiveness, or aggressiveness, of such a thing as a shrill whistle, or the vicious barking of a dog, or of a shooting pain, although due in part to certain characteristics of the stimulus itself, e. g., its inherent intensity or the suddenness of its appearance, is also due partly to the fact that such stimuli produce a change in the total effect of the sensory impressions to which we are accustomed.

(2) Changes in the total situations to which we are from time to time temporarily adjusted, or impressions that are incongruous therewith, excite attention. For example, the passengers on an ocean liner, accustomed to the splashing of waves, the creaking of beams, the whistles and bells of the boat, the whir of the propellers, human voices, are startled when they for the first time hear the cow-like bellowing of a siren or buoy. The sound attracts attention because of its sheer incongruity with the surroundings to which the passengers have become so quickly adjusted; on land, the sound would likely pass unobserved.

**The Subjective Conditions of Attention.** — It is not easy to draw a sharp line between the objective and the subjective conditions of attention, since many objects, catch the attention, by virtue of conditions, some of which are subjective and some objective. For example, shall we say that at a public gathering a disturbance in the gallery attracts our attention because it interrupts our listening to the speaker's words or because of some quality of the disturbance itself? perhaps on both accounts. So of many other stimuli: they excite attention on account of both their physical properties and because they interrupt or favor the trend of one's consciousness. And it is especially difficult to distinguish the subjective and the objective conditions of attention in respect to objects that are natively, or instinctively, interesting. For example, novelty, which we have classed among the objective conditions of attention, clearly belongs, from another point of view, to the subjective group; we naturally, instinctively, attend to novel things. Still, it is possible to enumerate a number of conditions of attention that are primarily subjective, belong to the observer's present consciousness or to his habitual mental trend.

The most general subjective condition of attention is mental wakefulness. When we are mentally alert, wide awake, mental processes easily attain clearness; whereas, if we are lethargic, drowsy, the components of the conscious stream tend to run on a dead level of dullness; nothing is prominent, clear.

A second subjective condition which favors attention is the possession of an image or idea of the forthcoming object; and this depends upon our having experienced it or its like on some earlier occasion. More popularly stated, the rule is that we can attend more easily, more readily, to a coming object if we know beforehand what sort of thing to expect. The teacher of biology does not rest with directing his students to go forth and study amœbæ and spirogyra; he knows that they must have at least a rough provisional mental preparation for finding and studying the specimens, so he first tells them what sort of things they are. In these and similar cases the mind is said to be prepared to apperceive, to attend to, the object when it is presented to sense. In short, attention to an object is facilitated if we have an anticipatory image or idea thereof or of objects similar thereto.

Perhaps most persons, if asked, what is the most important subjective condition of attention? would say, the will, purpose, or desire, to attend. And undoubtedly the cases of attention most frequently remarked originate in this way. We 'will' to attend in the face of distracting impressions to a given object of theoretical or practical interest; for example, to the meaning of a difficult paragraph and to become deaf to distracting noises; or, in pitching ball, to attend to the manipulation of the ball and to disregard the jeers from the bleachers. Now, the will or purpose to attend, as Pillsbury points out, 'shows three degrees of consciousness'. Sometimes the purpose controlling attention is very definitely present. Thus, to use Pillsbury's example, if one is shown for an instant a few bits of paper of different shapes and colors and is asked at the same time, — what colors do you see? one is able afterward to tell pretty accurately what colors were shown, but can tell little about their shapes. The question limited and defined the purpose of the moment and so the number of items that could attain clearness. At other times, the purpose, while present and operative, is less definitely conscious than when it is aroused by a definite question, as in the case just cited. Thus one gathers up the news items in the daily paper, but does not observe the size of the type or the number of columns on the page; or one visits a picture gallery and brings away images and thoughts concerning the pictures, but knows nothing of the construction of doors, windows, or floors. The general purpose, though only vaguely conscious, included in the one case the news of the day, but not the type and paper columns; in the second, it included an appreciation of the pictures, but not an inspection of the construction of the building. In other cases, the purpose falls within the scope of one's fixed mental habits and is even less definitely conscious than in the cases just cited. Illustrations are found in what we call the observational habits of the professional or business man. We say one naturally attends, and without being aware of it, to matters that pertain to one's trade or profession. The physician observes disease symptoms, the botanist observes plants, the farmer, crops and livestock, the architect, carpenter, or mason the features of building construction, the cook, the ingredients of foods, even in the complete absence of a definite purpose to do so. Attention is determined, in such cases, by the observer's bias, mental bent, the habitual trend of his thinking.

The influence of trend or general purpose in determining the objects of one's attention is illustrated in the case of a young student in a dramatic school whom the writer chances to know. This particular student, for certain personal reasons, has elected to play the 'old man' parts, and in preparation for his work gives a great deal of attention to observing the manners, speech, and mental traits of aged men. The trend of his purposive attention lies along this line. Accordingly, he sees and observes every elderly man while other persons escape his notice.

To summarize: the subjective conditions of attention are (1) mental alertness, (2) the possession of an image or an idea of the forthcoming object, (3) the purpose, or will, to attend, which may exist in varying degrees of clearness and definiteness.

**The Motor Concomitants of Attention.**— The everyday expressions, 'attentive attitude', 'strained attention', 'fascinated attention', 'brown study', and so on, refer pretty definitely to the motor concomitants of attentive states.

Some of these motor changes are characteristic of attention to sense objects; others belong rather to the imaginal and thought processes. It is, therefore, convenient for purposes of description to distinguish, (1) the motor concomitants of sensory attention, and (2) the motor concomitants of ideational attention.

One may also distinguish rather easily the motor concomitants of sensory attention, according to the immediacy with which they subserve the attentional consciousness, as either (a) accommodatory, adaptive, or (b) inhibitory.

The general and immediate purpose of the accommodatory, or adaptive, movements is, as the name implies, to bring the sense organs into those relations to stimuli that are most favorable for the reception of clear and distinct impressions. Thus, in looking attentively, the head and eyes are ordinarily turned toward the object, the two eyes converge so that the stimulus will fall upon the fovea of each, the most sensitive spot of the retina, and the lens is adjusted to the distance of the object. In listening attentively, the whole body tends to lean toward the source of the sound, or at least we turn the sharper ear in that direction. In painstaking 'touch', as when trying to determine the quality of a piece of cloth, or the smoothness of a surface, we work over the articles with the hands and fingers. In trying to determine the taste of a substance, we move the tongue so as to stimulate the most sensitive taste organs; and in order to get the clearest olfactory impressions we deflect the air currents upward to the olfactory area in the upper nasal cavity.

Besides these movements which serve immediately to adjust the sense-organs for the most favorable reception of stimuli, certain others subserve the functioning of the sense-organs indirectly by shutting out irrelevant or distracting stimuli; these latter are called inhibitory movements. The most easily observed inhibitory movements are — the cessation of bodily movements when looking or listening intently. Thus, if one is walking, the pace is slackened, or one even comes to a stand-still in order to listen to a faint sound. Breathing is also affected in all cases of wrapt attention to sensory stimuli; the rate of breathing is lower and the inhalations are not so deep, whence comes the expression, 'breathless attention'. Further, one may frequently observe that in listening, touching, tasting, or smelling attentively, the eyes are closed as if to exclude distracting stimuli.

The motor concomitants of ideational attention — attention to images, ideas, thoughts — though less conspicuous than those of sensory attention, are easily observed when they are once pointed out. In visual imagery the eyes often repeat the movements of actually looking at the imaged object. If one is imaging a high building or a mountain range the eyes tend to move up and down, right and left, as the image develops; or if the image is of something spread out in space, like a large painting or a college campus, the eyes also tend to move over the imaged area. This often involves, besides the movements of the eyes, actual or incipient movements of the head or of the whole body. Again, in trying to image sounds one may detect muscular tension in the region of the ears; in imaging tastes, moving the tongue and mouth parts facilitates the arousal of the taste image; olfactory imagery almost inevitably involves slight inhalation, as if to bring the odorous particles nearer the olfactory surface; and in tactual imagery one may easily find muscular twitching and tension in the fingers and hand. In fact, it is doubtful whether one can form clear and distinct tactual images if these muscular tremors are inhibited. In many of these cases of imaging, the muscular actions present may be viewed, to use Sully's words, 'as survivals or partial reproductions of the motor concomitants of the original sensations.'

The motor processes just enumerated may be regarded as concomitants of the rise and development of clear images. Other mental activities, more properly called thought processes, comparing, judging, reasoning, especially if they pertain to new and difficult topics, are usually marked by characteristic bodily attitudes: e. g., the whole body is motionless, the head is held in a certain position, the jaws are firmly closed, breathing is shallower, the pulse undergoes changes of rate and strength, the eyes are wholly or partially closed.

**The Sensory Concomitants of Attention.** — "With the motor concomitant phenomena [of attention],' says Külpe, 'are conjoined certain sensations, which thus constitute a characteristic factor in every process of attention. They are for the most part strain sensations, arising from the adaptation of the sense organs and the position of the body or limbs; and they are indicated in the phrases 'strained attention', 'intent' expectation, and so on."[1] (It is likely that if Külpe were revising his text, he would say strain sensations constitute a characteristic factor of 'some' or 'many' instead of 'every' process of attention.) The sensations of strain, tension, exertion, though often present in all three

[1] *Outlines of Psychology*, § 74, Titchener's Translation.

'forms' of attention, (voluntary, involuntary, non-voluntary), are characteristic of voluntary attention, and give rise to the popular but erroneous view that this form involves the consciousness of mental, or spiritual, activity in addition to the other conscious factors of the moment.

**The Degrees of Attention.** — Sensations and images show different degrees of clearness. To illustrate: suppose that at ten o'clock on a given day you settle down for an hour's work, at the same time recalling that at eleven you are to start to fill an important engagement. You get absorbed in your work and think nothing more of the engagement. The hour passes, and the clock begins to strike eleven. Now, under the circumstances described it is likely that the first strokes of the clock barely get above the threshold of consciousness; you are only dimly conscious of them; then the strokes that follow become clearer and clearer until toward the end of the series they are at a maximum of clearness, and monopolize the field of attention — until you think again of your engagement. In describing such an experience, we say that the consciousness of the strokes rises by degrees from dimness to perfect clearness, or that 'attention to' the strokes passes from a minimal to a maximal degree.

The fact of variation in the clearness of sensations and images may be represented by the accompanying diagram (Fig. 32), which is a modification of the one employed by Titchener to represent the two-level type of the attentive consciousness. In the figure, the raised part of the upper thin line represents the 'field of attention,' or clearness. Now, if we think of this raised part as rising to the levels indicated by the dotted lines, we shall have a representation of variation in degree of clearness, the number of lines in each case depending upon the number of degrees of clearness in which a given process may exist.

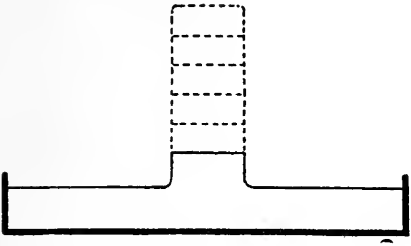

Fig. 32

It is popularly believed that the degree of attention depends upon and varies with the amount of muscular strain, exertion, effort that forms part of the total experience; that tense muscles, knit brows, and the like, indicate a high degree of attention, and that general relaxation, flaccidity of the muscles is symptomatic of a low degree of attention. Now the fact is that while this relation holds in some cases, the *consciousness* of strain or effort usually indicates a low degree of attention; ordinarily, maximal attention is marked by the absence or the obscurity of the feeling of effort.

The fact of differences of clearness within a given field of consciousness may be represented by a diagram of concentric circles, the innermost representing the clearest part of the field, the outer circles representing less and less clear parts. The number of circles which are employed in particular cases will vary with the individual observer's judgment as to the number of distinguishable degrees of clearness, or attention, that may coexist within the particular conscious field.

**The Range of Attention.**—One of the conventional topics of treatises on Attention is, how many things can we attend to at once? Now it is clear that the question, as it is usually stated, is full of ambiguities. What, for example, is meant by 'thing'? Do we mean something as simple as dots on a sheet of paper? or do we mean something as complex as orchestra music or a landscape or a city viewed from the roof of a sky-scraper? Again, are the 'things' the same or different in kind? If they are sense-impressions, are they all visual, or part visual, part auditory, part cutaneous? We must know precisely what is meant by 'things' before the question can be answered intelligently. Further, what is meant by 'attend to'? Is the consciousness of each of the several objects of attention clear or obscure? What is the position of the attended-to object or objects in the total conscious field? Further, what degree of clearness is meant? minimal or maximal, or some intermediate degree? Lastly, it is imperative that we give precise meaning to the words 'at once'. Do we mean one second or one-half or one-fifth or one-hundredth of a second? Even the expressions — 'momentary exposure', 'momentary glance', 'momentary stimulation' are too indefinite to be psychologically valuable. It is necessary to tell precisely what we mean by 'at once', 'a moment', 'an instant', and so on.

Experiments upon the range, or scope, of attention are sometimes conducted with the necessary care in respect to the foregoing points: but very frequently they are not; in the latter case, the results are worthless. And even when every care is taken to fix precisely the conditions of the experiment, certain other difficulties arise to plague the experimenter and to confuse the meaning of his results. To illustrate: in the simplest form of the experiment on the range of attention the observer is given a number of impressions—visual, auditory, pressure, what not — having been requested previously to tell how many there are, the meaning being — how many things did you see, hear, 'feel' during the period of stimulation. But since the stimulus excites processes in the sensory apparatus that continue for a time after the stimulus itself disappears, the observer reports not only the objects of which he was conscious at the moment of stimulation, but also those suggested by the after effects of the stimulus. In other words, the observer, instead of reporting only the objects of which he was conscious at the moment of impression, reports also all the objects that 'develop' in consciousness, i. e., get named, located, described, after the stimulus ceases. Accordingly, in this case, the observer reports the number of meanings that develop, rather than the number of things of which he was definitely conscious during the period of stimulation. Pillsbury puts this phase of the matter well:

"Careful observation," he writes, "of the process of determining the number of objects shows that even with short exposures the objects are not attended to at once, but are impressed upon consciousness and persist for a time in the memory after-image, where they may be attended to separately and counted. It is as if one took an instantaneous photograph of a group of objects and counted them on the film after development. The memory after-image persists only for a second or two, however, and the number of objects that may be seen with a short exposure depends upon the number that can be attended to and counted before the image disappears. It seems probable from all the experiments that only a single object may be attended to at once."[1]

In still other cases the observer confuses what he knows, or thinks he knows, about the object with what was focal at the moment of impression. For example, if the stimulus is the printed word 'psychology', and the observer is asked to report how many letters he saw, he will report more than he actually saw, even though he be forewarned. He sees a few of the letters, knows their customary associates, and irresistibly adds the latter to the ones actually seen.

Our conclusion, then, in respect to the problem of the number of things we can attend to at once is that the loose, general form in which it is ordinarily stated, does not admit of an answer: further, that in the experimental study of the problem, it is extremely difficult to adhere strictly to experimental conditions.

**The Forms of Attention.**— Strictly speaking, there is only one kind of attention. All cases of attention,

[1] *The Essentials of Psychology*, 1911, p. 124.

i. e., all clear consciousnesses, are alike, in kind. But they may differ in respect to their conditions and their concomitants, and these differences are made the basis of the classification of the several 'forms' of attention; namely, voluntary, involuntary, and non-voluntary.

Voluntary Attention. — One distinctive mark of voluntary attention is that it is preceded by an express volition, a definite purpose to attend. We 'will' to attend to the details of a laboratory experiment, to the grammatical forms of a foreign language, to the unfolding of the plot of a novel. Again, voluntary attention arises and is maintained in the midst of conflicting tendencies. Our 'will' to attend to the experiment conflicts with our desire to talk to a classmate or to be on the ball ground or simply to do nothing in particular. And conflict involves muscular tension, changes in heart-beat and rate of breathing, and other unlocalized organic changes, together with their resulting sensations and feelings which we group together under the expression — the consciousness of effort. Accordingly, voluntary attention is said to occur in a complex setting of sensations and feeling characteristic of the consciousness of effort; this is its second distinguishing mark, which together with the 'antecedent purpose', already mentioned, serve to distinguish voluntary attention from the other two forms.

Involuntary Attention. — Voluntary attention, we saw, presupposes an express purpose to attend to a given object. The distinctive mark of involuntary attention, on the other hand, is that it arises in opposition to the general purpose or interests of the moment. It involves a disturbance of the conscious 'set', the dominant trend of one's mental processes. As the term *in*voluntary implies, it is attention against the will, so to say. Further, whereas voluntary attention depends primarily upon a prior volition, involuntary attention depends rather upon the nature or attributes of objects. Stimuli possessing certain properties, certain kinds of images and thoughts, arouse involuntary attention. Thus, suppose one is engaged in adding a long column of figures when suddenly a book falls from the shelf, upsets the ink-well and blotches the column one is adding, etc.; one cannot help attending to the disturbance. In general, intense, sudden, unexpected stimuli, noises, flashes of light, disagreeable odors, twinges of pain, force attention upon themselves and displace the objects of voluntary or non-voluntary attention. It is, perhaps, unnecessary to cite illustrations of the fact that images or thoughts that are strongly tinged with emotion — say anger, or love, or joy, or grief, or hope, or fear, or anxiety — tend to obtrude themselves into the stream of consciousness often against our best efforts to keep them out and to attend to other matters.

**Non-Voluntary Attention.** — Non-voluntary attention is best described by noting wherein it differs from the other two forms. As contrasted with the voluntary, purposive attention and its attendant consciousness of effort, the non-voluntary form arises spontaneously and runs its course freely: it is purposeless, effortless. Contrasted with involuntary attention, which marks a disturbance of the trend of consciousness and which is often accompanied by disagreeable feelings, the non-voluntary form arises in a field that is relatively free, in which there is no conflict, and its course is marked ordinarily by agreeable feelings.

Popularly expressed, non-voluntary attention is attention to objects that are interesting, that have emotional coloring. The 'interest' may be native, instinctive or acquired, derived. Intense, or suddenly appearing stimuli are natively interesting; so also are, to use James' list, strange things, moving things, wild animals, bright things, pretty things, metallic things, words, blows, blood, etc., etc. Non-voluntary attention is thus characteristic of childhood; attention to animal pets, colored toys, plays, games, child companions and the like make up the round of the child's activities. But our interest in an object may be acquired, derived. Perhaps most of the interests of adults are of this sort. The student's interest in his problems, the merchant's in money and markets, the lawyer's in cases and court decisions, the physician's interest in the newest discoveries in pathology are mainly derived, but they nevertheless often possess all the warmth and energy of our native interests, and the objects to which they attach no less certainly impel attention of the non-voluntary kind.

**Popular View of Attention.** — It remains to describe two or three defects of the popular conception of attention. In the first place, the popular meaning of attention is extremely variable, so variable, in fact, that the term covers by turns all of the mind's activities, conditions, and affections. Sometimes, perhaps most frequently, it is used synonymously with mind, or consciousness. This is its meaning, apparently, when one speaks of attention as wandering, or as being fascinated, or as focussed, concentrated, or of the 'field' of attention. The meaning would be the same if one spoke of mind as wandering or of the focusing of consciousness, instead of the wandering, focusing, and so on of attention. It would probably be safe to assert that in three-fourths of the statements in which 'attention' occurs, one could substitute for it the word consciousness or mind without altering the meaning.

At other times, attention is described as the peculiar power which the mind possesses of concentrating, or focusing, itself upon one of a number of possible objects; it is the mind's concentrating faculty, the faculty whereby the field of consciousness is contracted. In this meaning, attention is like the ability one has to limit the visual field to one of its objects or features, say a given tree's mode of branching or to the color of the brick in a given building, instead of looking at the landscape as a whole. In fact, the act of limiting the visual field and of looking at one object or aspect thereof is supposed to be just one form of attention's activity.

Attention in the meaning just indicated, i. e., as the power whereby the extent of the field of consciousness is limited, seems to relate primarily and chiefly to changes in the mind itself. At still other times, 'attention' means, apparently, a special way in which the mind attacks its objects. The expressions — attention seizes, grasps, catches — suggest that it is a kind of prehensile organ which the mind employs in securing objects for careful consideration. It is the activity whereby the mind selects, in the face of difficulties, one of a number of possible objects for examination. For example, we speak of attention seizing upon one feature of a complex phenomenon, say the tones of some one instrument in an orchestra, while the others are neglected.

In the two senses last mentioned, attention is conceived of as a form of mental activity. In the former — concentrating, focussing — the activity consists apparently of changes within the conscious field itself; in the latter — selecting, seizing — it is outgoing, it is a way in which the mind is supposed to act upon its objects.

We have just spoken of the variety of meanings that attach, in everyday speech, to the word attention. A second serious defect of the popular use of the term is its extreme vagueness, or generality. To say, for instance, that a man's attention wanders or is diverted from music to money, that it is focused now on the one, now on the other, and that finally it is quietly slumbering, really tells us nothing definite about the man's conscious processes. It is as if the scientist should tell us that electricity wanders, lingers, that it is lured, captured, freed, without telling us anything in detail about its wandering, lingering, and so on. We should say, and rightly, that he is giving us metaphors instead of information. Again, to say that attention is the mind's power of concentrating itself, or of seizing objects, is once more to put us off with incomplete statements. We should ask, "concentrating in what respect? What precisely is meant, in this case, by 'seizing'?"

Third, the popular conceptions of attention originate in, or at any rate, are closely bound up with, the erroneous notion that the mind is some kind of indwelling material entity, substance, force, or creature. If one sets out with this conception, it is an easy step to the thought that the mind has the powers and attributes of other material things; it then becomes easy to think of mind as wandering, as being captured, as being concentrated, as seizing objects and so on, as occasion may require. But if we discard this physical conception of mind and think of it as the sum total of our conscious processes, then these popular descriptions lose their meaning. Our theory of attention must agree with our theory of mind.

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# CHAPTER VIII

## ASSOCIATION

**Associative Connections.** — The student who has watched the trains of imagery, ideas, thoughts, impulses, desires which from hour to hour make up his stream of consciousness must have observed certain uniformities in the order of the appearance of the items composing the stream. It must have been observed, for example, that, as a rule, the sight of the date, '1492' is followed by the thought — 'Columbus-discovered-America'; that the word 'home', seen or heard, is usually followed by images and thoughts of one's own home; that A suggests B, that '6+6' suggests '=12', that one line of a familiar verse revives the next.[1] Uniformity in the order in which many conscious processes follow one another forms a conspicuous feature of our mental life.

It must also have been observed that what sometimes appears, to superficial inspection, as the bewildering and lawless flight of one consciousness after another is really, as closer study shows, a process which is subject to laws as rigid as those governing the conscious revival of the letters of the alphabet; that many of the seeming gaps in the

[1] The popular terms 'revive', 'recall', 'suggest,' and the like mean here, and elsewhere in this text, 'is,' 'are,' 'will be,' etc, immediately followed by'.

conscious stream can be bridged over by closer scrutiny. The following passage from Hobbes is frequently quoted to show that we are often able to retrace the steps which have lead to seemingly abrupt and irrelevant thoughts and ideas:

> "In a discourse of our present civil war [in England] what could seem more impertinent than to ask, as one did, what was the value of a Roman penny? Yet the coherence to me was manifest enough. For the thought of the war introduced the thought of delivering up the King [King Charles] to his enemies; the thought of that brought in the thought of the delivering up of Christ; and that, again, the thought of the thirty pence, which was the price of that treason. And thence easily followed the malicious question."

Furthermore, if the student carries his reflections a little farther he will notice that some of his perceptions and thoughts are followed now by one, now by another, of their former associates, and that it is frequently impossible to predict with certainty which one shall arise on a given occasion. Thus the sound of the bare word 'gold' may revive any one of a multitude of its former mates, e. g., an image or thought either of the color of gold, of a gold coin, a gold watch, gold dust, gold mine, Golden Rule, gold and silver, diamonds, California, the Klondike — any one, to repeat, of 'gold's' former mental associates. Again, if the student knows something of the life of the first Napoleon, the sight of the Emperor's name is followed with equal ease and frequency by either 'Waterloo', or 'Wellington', or 'St. Helena', or 'Paris'. And so of multitudes of other words; they have been linked in past experience to a vast number of images and thoughts, any one of which may now be revived therewith.

Finally, the student may have observed that at times he is unable to account for the appearance of certain of his ideas and images; they bear no discoverable relation to the other features of his present mental life, they seem to arise spontaneously, to come 'out of the everywhere'.

In brief, the items in the mental stream seem sometimes to be bound together by strong and easily discernible bonds; at other times the threads of connection are fine and lie far beneath the surface; on still other occasions it is altogether indeterminable which one of a multitude of possible consciousnesses shall sprout out of the one just fading; and, finally, many mental processes seem to shoot into the conscious stream out of 'the clear blue'.

Observations, such as we have just mentioned, have given rise to numerous attempts to describe the associations, or associative connections (especially in respect to their differences), which spring up among the components of our mental life; and also to describe the conditions under which they first occur. We shall presently undertake to summarize the results of these efforts; but first two remarks, by way of definition, are required.

(1) An 'association' or 'associative combination', as we are now using these terms, is an acquired connection, of such a nature, among certain of our perceptions, images, and thoughts that when subse-

quently one of the members of a given combination reappears, its earlier associates also tend to appear.

The so-called 'laws of association of ideas' assert that under certain conditions two or more ideas become related in such a way that when one of them reappears the other or others also tend to reappear. In modern psychology the tendency is to abandon the expression 'laws of association of ideas' and to speak instead of the 'conditions' of association, meaning thereby the conditions under which associative connections, such as we have just mentioned, occur.

(2) It is a little curious, at first thought, that the only evidence we can have that an associative connection between given conscious processes exists is that the appearance of one is actually followed by the appearance of the other or others. The school boy may insist that he knows who wrote 'The Legend of Sleepy Hollow', but until he is able to say 'Irving' we may still doubt that that associative combination has ever existed in his mind. Again, the only convincing proof that a memory hero can furnish of his ability to enumerate forthwith all the important political, social, economic, educational, and literary events of any year of Queen Victoria's reign, which we may choose to name, is that he shall actually do it. Accordingly, from this point of view our task would be (1) to describe typical instances of associative revival, and (2) to set forth the conditions of their occurrence. This phase of the subject, however, seems to belong rather in a chapter on MEMORY, and we shall defer it until we reach that topic. For the present we shall limit our study to a description (1) of certain variations

among associative combinations, and (2) to a statement of the conditions favorable to the formation of such combinations.

**Variations among Associative Combinations.** — Associative complexes vary in respect to — (1) the nature of their components; (2) the number of items they comprise; (3) the permanence of the grouping of their terms; (4) the intimacy of the connections among their components.

(1) In reference to the first kind of variations we may observe, first, that associative complexes may consist either of perceptual factors as, e. g., when thoughts of the color, coldness, hardness, smoothness, weight, 'ring' when struck, of a piece of steel are linked together; or of imaginal factors, as, e. g., the image of a city, say Athens or Jerusalem, which one gains from others' descriptions; or they may consist of both perceptual and imaginal elements; for instance, one's knowledge of the sun includes the sensory materials — color, warmth, location, supplemented by the images of its immense size, enormous heat, eruptions, storms, flight through space, which the astronomer supplies to us.

We observe, second, that the components of associational complexes may consist either of elements which arise in homogeneous fields of sense-experience or of those belonging to different sensory departments. In the former case, touches are combined with touches, sights with sights, sounds with sounds, and so on. For example, the several visual features of the persons whom the little child sees often, those of the rooms in which he spends his early days, the numerous objects of familiar outdoor scenes, become linked together so that the sight of any one tends to revive the others. And of course, for grown persons, if they have any power of visual imagery, glimpses, part views, fleeting glances are continually recalling to the mind's eye fully rounded images of acquaintances, friends, familiar landscapes, buildings, vehicles, animals, maps, pictures, printed music, mathematical formulas; bare glimpses of even the words we are now reading are sufficient to revive them in their entirety. In like manner, sounds begin very early in the child's experience to fall into groups or clusters so that the appearance of one is at once followed by its customary associates. The order of sequence of the sounds of nursery rhymes and songs is a case in point. In older children and grown persons the notes of a melody or the words of a poem become linked together in a given order so that the sound of a single note or word is followed by the imaged sounds of the others.

The associations just mentioned arise within the same sense-department. Far more conspicuous, in everyday experience, are those which spring up between the different kinds of sensory materials; for example, between visual and auditory, auditory and tactual, tactual and visual, visual and gustatory perceptions and images. These combinations, too, form a prominent feature of the first steps in the child's mental development. For instance, a visual image of the mother is connected with the sound of her voice; the touches of given objects are linked with the way they look; the 'look' of an object suggests that it is rough or smooth, cold or warm, soft or hard, heavy or light; the odor of a nauseous drug revives its name, color, taste, together with those particular organic sensations which it produces when swallowed. Associations also grow up very early between given actions on a child's part and definite sensory experiences, e. g., a child's shaking a bell to hear it ring.

The kindergarten game in which an object, say an orange, is placed in the hands of a blind-folded child with the request that he name it and tell as much about it as possible is obviously a test of the associations between immediately present and past sensory experiences.

(2) An associative complex always comprises at least two terms — as the image of a color and the thought of its name, the thought of a certain building and of certain of its features — though it may contain a great many more, the number in each case being limited only by the number of terms which, in the individual's experience, have occurred in relations effective for association. When we say popularly that one person's knowledge concerning a given thing is richer, fuller, more nearly complete, than another's, we mean that the associative connections in respect to the thing are more numerous in the mind of the first person than in that of the second.

(3) Associative complexes vary greatly in respect to the permanence of the ties whereby their components are linked together. Objects and their names, words and their meanings, things and their uses,

events and their dates, actions and their results, are examples of associations which easily acquire and retain a high degree of permanence in most minds; while the scientific names of common plants, the names of eminent men who were contemporaries of, e. g., Julius Cæsar, the *dramatis personae* of a Greek tragedy, though easily learned in school days, soon thereafter fade away because, ordinarily, the conditions for their retention are not operative. Other things being equal, the associative combinations formed in childhood are more durable than those formed in later years.

(4) By variations among complexes in respect to the intimacy of the connections of their components is meant the variations in the degree of probability that the appearance of one of their members will involve the appearance of the other or others. Thus, for most of us the perception or image of the word 'Romeo' is more likely to be followed by the word or thought 'Juliet' than it is by the thought 'Shakespeare'; 'wigwam' more frequently revives the word 'Indian' than it does 'place of shelter'; 'shooting-star', the thought or image of 'a streaming light in the heavens', than thoughts of other stellar phenomena, and, in each case, because the associative connection between the first and second terms of these series is closer than it is between the first and third. This sort of variation depends partly upon the conditions of associative combination which we are now to study.

A further illustration of the variations among associative combinations as regards the intimacy of the connection of their components is the fact that if one has learned the names of the presidents of the United States in the order of their incumbency, and only in that order, and if one is called upon to repeat them, it will be easiest to begin with Washington and proceed name by name to that of the last incumbent, although it is also possible to name them in any other one of a multitude of orders, which shows that, in addition to the close associative ties between the several members of the series and their immediate successors, many other bonds of varying intimacy have been formed. In fact, every member of the series is, in some degree, linked to every other member.

**Conditions Favorable to the Formation of Associations.**— The conditions which favor the formation of associative connections among conscious processes — perceptions, images, and ideas — comprise, (1) certain characteristics of the processes themselves; (2) certain relations in which they occur; and (3) a group of conditions which are, in a measure, external to both the processes and the relations immediately involved. We shall consider them in the order named.

First in importance among the characteristics which increase the associative possibilities of conscious processes are those of vividness and distinctness. Thus, if one examines the image formed in a momentary glance at a picture, or a land-scape, or a building, which one has never before seen, one finds in the image those features which in perception were life-like and clearly defined, which, in a word, 'caught the attention'; and they are the features which, unless they are supplemented by later observation or undergo other modification, constitute one's permanent image of the object. Further, the difference between two mental processes in respect to their effectiveness for association with other mental processes is related closely to their differences in respect to their vividness and distinctness. Other things equal, a mental state which has these properties will enter into more associative connections and more readily than one that is dull and blurred.

A second group of conditions which favor the formation of associative combinations among conscious processes consists of certain relations which they bear to one another. The most obvious of these, and also the most important, is that of temporal contiguity. Other things equal, mental processes, which occur at the same time, or in immediate succession, in the same 'conscious present', are likely to become linked together. A familiar illustration of this fact is that the student's images and thoughts of buildings, trees, class-mates, library, subjects of study, laboratories, books, examinations, tend to form an associative system, a constellation of what we call school topics. Other familiar examples are the connections that arise between the thoughts — moon and stars, judge and jury, doctor and patient, river and bridge, horse and wagon; but the principle is so simple and so obvious that further illustrations, if desired, will readily occur to the student. Associations whose formation depends chiefly upon the temporal proximity of their components are said to arise according to the law of contiguity.[1] Closely related to the influence of bare contiguity in producing associative ties among conscious processes is that of frequency of repetition of the processes, either simultaneously or in immediate succession. The effectiveness of repetition in the formation of associations is illustrated in the method ordinarily employed in learning an alphabet or the spelling of words or the multiplication table, the conjugation of Latin verbs, lines of poetry, prices of goods, the locations of post-offices, if one is preparing for a postal clerk's examination. The more frequently two or more processes occur in the same conscious present the more likely it is that they will form an associative complex.

It was said, when enumerating the conditions which facilitate the formation of associations among conscious processes, that one group of conditions lies somewhat outside both the processes themselves and the relations immediately involved. This group includes (a) the 'will' to group one's ideas in regard to particular objects, (b) an accompaniment of intense feeling or emotion, (c) mental alertness, and (d) a clear apprehension of the relations in which a series of objects stand to one another. Thus (a) it is evident that the will, or purpose, to group one's ideas in regard to the causes of the Civil War in the United States, or the names of the animals that lived in a given geologic age, is a potent aid thereto. (b)

[1] For criticism of the view that bare proximity in time is sufficient to generate associative combinations, see STOUT, *The Groundwork of Psychology,* 1903, pp63, f., 117 f.

It is a familiar observation that a series of mental experiences occurring in a setting of intense feeling or emotion, i. e., that have intense emotional accompaniments, are likely to become welded into a relatively compact group. Thus, suppose that one is aboard a sail-boat that capsizes, and that one's life is long in peril; then, ever afterwards, thoughts of sail-boats will likely recall items of the one dreadful experience. Further, other things equal, a mental state which is rich in emotional concomitants will enter into more associative connections and more readily than one that is poor in emotional coloring. (c) It is equally clear that associative ties among conscious processes are more likely to form when one is mentally active than when mentally drowsy or sluggish. (d) The associability of a series of consciousnesses is enhanced by the observation that their objects stand in certain relations — e. g., temporal or causal or qualitative — to one another. Thus the thoughts of objects as antecedent and subsequent, e. g., 'Christmas' and 'New Year's', or as cause and effect, e. g., 'polluted water supply' and 'epidemic of typhoid', or that are observed to be in some respects similar — tones of different musical instruments or words used synonymously — tend to become associated. Another illustration of the associability of thoughts, whose objects are observed to be similar, is that the thoughts of a number of printed words, which the student identifies as the names of certain English poets, tend to fall into a group more readily than if no such similarity of meaning is recognised. Again, the words Albany, Buffalo, Cleveland, Indianapolis, St. Louis, Kansas City, as the naked names of several cities, have but slight tendency to become associated. But if one is planning a trip by rail from Boston to some point in central Kansas, and is told that he will have to change coaches at the cities named, then, because of their common characteristic — places-to-change-cars — the names of these cities will readily fall into a group in the traveler's mind. The same principle is illustrated in the organization of many of our school subjects. For instance, geography, geometry, physics, American history, as school studies, each consists of selected facts, observations, principles, laws, in reference to things which possess recognized similarities.

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## CHAPTER IX

### MEMORY

**Definition.** — A certain portion of our mental life consists of knowledge of our past experiences, knowledge of having seen certain persons, visited certain places, of having been engaged in given kinds of work or play or games, of having experienced certain emotions, uttered certain opinions or judgments, of having decided upon certain courses of action. Knowledge of this kind is ordinarily called Memory; or, with a slightly different emphasis, we may say — Memory is the knowledge of our former experiences *as such;* the experiences are known as *ours,* and as having occurred in *our past.*

In order that we may more easily perceive the essential factors of the memory experience, let us suppose that there arise in our consciousness images and ideas of our having heard on a given occasion some noted orator. Let us suppose further that, at first, the images or thoughts relate to the speaker himself, his name, appearance, manner, possibly the sound of his voice, or are merely images of words and sentences uttered. Then, if we dwell on the scene, we may think of persons seated on the stage beside the speaker, the hall, platform, decorations, the emotional reactions of the audience, our companions, and so on. But the rise in consciousness of vivid and exact images of an object or event, even though they be accompanied by a multitude of revived associates, would not in itself constitute a memory, since obviously the images might all appear as features of a purely fictitious creation, as in a dream, as figments of imagination, or as pictures of a possible future event. In order that my knowledge of a given event shall be regarded as a memory, it must be accompanied by the belief that it occurred in the past; the idea of 'pastness' must attach to the things of which I am now conscious. Now, the thought of 'pastness' arises and is supported or corroborated by a simple process of association. The event remembered occurred in a certain year, during a certain presidential campaign, when certain political questions were in the foreground, the year in which Mr. Roosevelt was elected president, and so on.

But the mere thought of an event as belonging to a definite point in the past does not alone make of it a memory. For obviously the thought of historical occurrences, such as Julius Caesar's assassination or the battle of Waterloo, may include the thought of their pastness, although no one now living speaks of remembering those events. Memory, in the strict sense, involves the further belief that the remembered experience belongs to my own past. Now the belief that a given remembered fact belongs to my own past rests mainly upon two sets of experiences. First, I observe that it harmonizes with and is corroborated by a number of my other verifiable memories, it forms a link in a chain of fully authenticated earlier experiences. Thus my memory of having heard on a given occasion a certain orator is supported by the memory of a number of other occurrences, some of them prior, some subsequent thereto, e. g., of the announcement that he would speak in a given city at a given time, that I was in the city at the time, engaged in certain work, that a given person accompanied me to the meeting, that certain other persons were present, that I went to a given place from the meeting, reviewed the address with my friends who were also present, and so on. In the second place, a remembered fact or event has a feeling or emotional accompaniment which is variously described as 'warmth and intimacy' (James); as 'a glow of warmth', 'a sense of ownership', 'a feeling of ease', ' comfortable feeling' (Titchener.) In a word, the sense of 'myness', which forms an essential feature of every memory consciousness, consists of (1) the sense of congruity with my other memories which attaches to the remembered event, and (2) the feeling or emotion of warmth and intimacy, or at-homeness, which is awakened by the thought of the event.

Generally speaking, psychologists are agreed as to the characteristic marks of memory and the memory consciousness. To be sure, the terms employed and the points of view differ somewhat from author to author; but there is substantial agreement as to the characteristics of the phenomena. Compare, for example, the descriptions of James and Titchener. The former, after pointing out that no memory is involved in the mere fact of 'the revival in the mind of an image or copy of the original event', and 'that the successive editions of a feeling [a consciousness] are so many independent events, each snug in its own skin', teaches that a memory consciousness involves two further thoughts: first, the fact remembered must be expressly referred to the past, thought as in the past; second, 'I [the person in whose mind the memory occurs] must think that I directly experienced its occurrence'. In like manner, Titchener first reminds us that 'no idea is a memory in its own right'; or, in the words of a later work, that 'no image or idea is intrinsically a memory-image or a memory-idea' . . . . Then that 'an idea comes to us as remembered only if it comes to us as consciously familiar', accompanied, that is, by 'the feeling of familiarity'. Now 'the feeling of familiarity', which, for Titchener, is the memory label, the distinctive mark of a memory, implies James' 'thoughts' that an experience belongs to the past and that it belongs to *my* past. For clearly the feeling that an experience is 'familiar' implies the feeling, or awareness, that it has been known previously and by me. In brief, both James and Titchener teach that one's memory of a fact or event includes, besides the knowledge of the remembered fact, the consciousness that it belongs to one's own past.

The Conditions of Memory. — In the foregoing paragraphs, we have said that memory is the knowledge of our past experiences *as such*. We have said also that the characteristic features of the memory consciousness are, (1) certain images which mean items of our past experience; (2) emotional and ideational factors which certify that these items belong to our own past. We shall turn next to the conditions of the appearance of the images of our past experiences.

It is assumed in the preceding paragraph that memories are usually mediated by images. To illustrate: in order to remember that I once met B. in Washington, images of B.'s name, of his appearance and manner at the time, of other persons present, of the surroundings, of the words—'met B.

in Washington' — some or all of these which mean that particular event must appear in consciousness.

The nature of the mental state which means a given remembered event varies from individual to individual, and from time to time in the experience of the same individual. But, as a rule, a memory involves the presence of either concrete or symbolic imagery which serves as its vehicle.

Then immediately the question arises — where are the vehicles of our memories when they are not in consciousness? And this question brings us to the central problem of memory so far as it involves the retention and the representation of definite portions of our past experience.

In the older psychological literature, the treatment of no topic is more completely cast in figurative language than that of memory. Thus we read, to instance only a few of the more grotesque and more mischievous figures, of memory as 'a storehouse' in which ideas are stored away for safekeeping, as 'a tablet' upon which impressions are traced, of memories 'that are wax to receive and marble to retain', of ideas being 'linked together' like the links in a chain. Now expressions of this sort may be permissible, provided, we remember that we are speaking figuratively rather than in the language of literal fact. "We may still speak," writes McDougall, "of ideas being stored in the mind and being associated together, just as we may still say of a man that he carries the image of his beloved in his heart, but the two expressions have the same sort of validity only. They are picturesque survivals from the age of ignorance."[1] Psychology no longer employs such expressions to explain the phenomena of retention and revival.

**Retention.** — How, then, shall we explain the undoubted fact that our experiences do in a sense persist? How shall we explain the fact of retention? The modern explanation of this fact is based upon, (1) the law of psycho-neural correlation, namely, that every psychosis has its neurosis; or, more specifically, that every mental process is accompanied by changes in the cerebral cortex; and (2) upon the law that a cortical process, once induced, tends, under given conditions, to recur, and that whatever conscious processes have been previously correlated therewith also tend to recur. For example, the perception of a steamboat is accompanied, according to the first law, by given changes in the cortex; these changes, according to the second law just stated, tend to recur; if they actually do so, then we think of, or image more or less perfectly, the vessel. The retention of the consciousness of an object or event depends, accordingly, upon the retention of the tendency of the nervous processes formerly correlated therewith to recur. If this tendency fades out, and if the function has not been taken over by some other cortical area, then our knowledge of the object likewise dies away. In brief, the teaching of modern psychology is that in the course of experience our nervous system acquires tendencies, or dispositions, to act in certain determinate ways; and that conscious processes are cor-

[1] McDougall, Physiological Psychology, 1905, p. 119.

related with some of these tendencies and are said to be retained thereby. Retention is a fact of the physical or physiological order; it is not a mental fact or process at all. It is not the mind, but the nervous system that retains experiences.

The Process of Revival. — The retention of an earlier experience, we have said, depends upon the physiological fact that changes once induced in the cerebral cortex persist in the form of nascent tendencies to recur. Now, the physiological basis of revival, or recall, is the same as that of retention, with the one important difference that in revival we have, instead of the mere tendencies, or dispositions, of the aforesaid neural changes to recur, their actual recurrence; and their recurrence is due, in most cases, to the impulses that spread from cortical areas that are associated with those excited by the original experience. "If," says Sully, "we suppose retention to involve a persistent state of suppressed or nascent excitation in the central elements involved, we may say that revival depends on a sufficient intensification of this nascent excitation;" and it may be added that, in cases of associative revival, this "sufficient intensification" is caused by the irradiation of nervous impulses from other functionally connected central elements.

So much for the physiological conditions of revival. Let us turn for a moment to the mental side. The psychological principles which in the main control the revival of images and ideas have been indicated already in our chapter on Association. It will be sufficient at this point to recall the general conclusion stated there, which was, in brief, that when one of the members of an associative combination reappears, its earlier associates also tend to appear. From this it follows that the most general condition of the revival of a past mental process is the revival first of one of its earlier associates. Now, the earlier associate, the cue, which 'suggests', or calls up, the particular conscious process, may be either an image or idea or perception or sensation. Thus the image of the Liberty Bell recalls thoughts of when and where we first saw it; the sight of a great boulder reminds one of glacial markings we have seen elsewhere; a twitch of pain in the arm calls to mind the appearance of a certain sufferer from rheumatism. Memories of this sort are awakened involuntarily, in rambling states, when consciousness wanders on aimlessly from one process to another. A little later, we shall study voluntary, purposive, memory, or recollection, and we shall then see that the mechanism of the revival itself is essentially the same as in passive, involuntary recall.

**The Sequence of Imaginal and Ideational Processes.** — One palpable conclusion of the foregoing discussion of the process of revival is that the most general condition of the revival of one image or idea by another is that they shall have previously occurred together, shall have been, on some former occasion, factors in the same 'conscious present'. This general condition depends in turn, as we saw, upon the law of neural habit, the law, namely, that when two or more cortical activities occur simultaneously or in immediate succession the recurrence of one of them tends to revive the others. It is, moreover, generally agreed that the *sequence* of our imaginal and ideational processes is controlled by the law of habit, that in a train of images and ideas the fading portions are usually followed by some one of their former associates.

But since, in the course of experience, an image or an idea may have had numerous associates, the question arises which one of all these shall appear in its wake on a given occasion. The word 'Shakespeare," for example, very likely has in the reader's mind a multitude of associates—names of the poet's plays and the characters thereof, the names of famous Shakespearean actors, of Shakespearean scholars, of the poet's contemporaries, images of the Shakespeare house at Stratford, or of Shakespeare portraits, thoughts of the Shakespeare-Bacon controversy, and so on and on. At one time, the perception or thought of the name "Shakespeare" is followed by one of these; at another time by some other, and the question arises, what determines which one of all these possible successors shall actually appear in a given instance.

Now it is clear that appeal to the law of habit as an explanation of the order of the appearance of our images and ideas carries us only part way toward an answer. This law affirms that some one of the earlier sequences tends to be repeated, but it does not tell us which one. Otherwise expressed, the train of associative revival may be said to be run by the law of habit, but, so far as this law is concerned, it remains wholly indeterminate in what direction, on what track, it shall run. To take the instance already cited: we have to look beyond the general law of habit in order to see why the word 'Shakespeare' is followed at one time by — 'The Tempest'; at another, by 'Stratford'; at still another, by 'Portia', and so on. We have to look to another set of influences, sometimes called the secondary laws of association, for light on this latter question, and it is next in order to state and illustrate some of these laws.[1]

(1) FREQUENCY. The law of frequency is that other things equal, an image or idea which has been frequently associated with another tends, on its recurrence, to revive the other. For example, the thought, 'text-book of geometry' will likely recall the one used in studying that subject; or, the words 'Emancipation Proclamation' suggest the name of Lincoln, who issued it.

(2) RECENCY. If you have recently associated in thought two or more objects, then the recurrence of the thought of one of the objects is likely to revive the thought of the other or others. Thus the word 'Tennyson' recalls a verse recently quoted in our hearing and ascribed to that poet; 'Prima donna', the name of the one who recently visited our city.

(3) MOOD. One's temporary emotional state or one's mood influences the trend of one's images and ideas. It is well known that when one is depressed

[1] It should be noted that some of the general conditions of the formation of associative connections, e. g., contiguity and frequency of repetition, are also conditions of associative revival.

in spirits the air is full of birds of ill-omen, and that when one's mood is joyous the thoughts and images that stream into consciousness are likewise cheerful and happy. If, for instance, our dominant mood is a happy one, the thought of 'summer' revives thoughts of bright days, of flowers, of babbling brooks, of singing birds; but if it is gloomy, then one can think only of oppressive heat, sunstrokes, clouds of dust, sleepless nights, and the like.

(4) CONTEXT. Context is a potent factor in determining the direction which a conscious train shall take at a given moment. To illustrate, let us take the following well-known passage from James:

> "Why is it," he asks, "when we recite from memory one of these lines:
>
> "I the heir of all *the ages* in the foremost files of time,"
>
> and —
>
> 'For I doubt not through *the ages* one increasing purpose runs',
>
> and get as far as 'the ages', that portion of the *other* line which follows, and, so to speak, sprouts out of 'the ages', does not also sprout out of our memory, and confuse the sense of our words? 'Simply because,' he answers, 'the word that follows 'the ages' has its brain-process awakened not simply by the brain-process of 'the ages' alone, but by it plus the brain-processes of all the words preceding 'the ages' . . . . . . . When the processes of, 'I, the heir of all the ages', simultaneously vibrate in the brain . . . . . 'in' and not 'one' or any other word will be the next to awaken, for its brain-process has previously vibrated in unison not only with that of 'ages', but with that of all those other words whose activity is dying away."[1]

A more familiar, even if more prosaic, illustration of the influence of context is found in the dif-

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[1] *Principles of Psychology,* vol. I, p. 567 f.

ferent meanings, the varying associations, which many words have, owing to change in contexts. Thus, if one is engaged with astronomical matters, the word 'star' means a heavenly body, it reminds us possibly of other like bodies, their paths, distances, relations to one another, and so on. But if the general topic of our discourse is theatres or ballgames or decorations, the meaning and the revived associates of 'star' will likely be very different.

(5) Dominant interest or purpose. The interest or purpose of the moment is perhaps the most potent factor in determining which of several possible ideas each of the successive portions of a conscious train shall awaken. Thus, if one is drawing up a list of American poets, the thought of Longfellow is more likely to be followed by thoughts of Whittier, Lowell and Poe, than by thoughts of Longfellow's poems, or of incidents of his life, or even of other American writers who are known only as novelists. Again, if one's dominant interest, for the time being, is in metals, the word 'gold' is more likely to revive thoughts of 'iron', 'zinc', 'copper', than it is ideas of gold coins, or gold watches, or jewelry.

Primacy. It is held by some writers that 'first associations' are more 'intimate' (in the sense described on p. 192) than later ones. It is said, for instance, that the words 'ocean voyage' are more likely to be followed by thoughts of one's first voyage than by those of later ones; that thoughts of the events of one's first visit to a strange city are more likely to follow the thought of the name of the city than are thoughts of later visits. In the present writer's view, however, it is doubtful if 'primacy' independently of other factors, such as purpose, mood, frequency, ever determines the direction of associative revival; that is, unless first associations occur in an intense emotional setting, or are frequently repeated or are otherwise fixed, they are no more likely to recur than lates ones.

The reader may have remarked, in the preceding paragraphs, the frequent occurrence of the statement, 'other things equal', so and so will or is likely to occur. Probably it would have been better to have said, 'in the absence of other influences or factors', the one or ones named will determine the direction of associative revival. Thus, to take a case already cited, the thought of Longfellow will be followed by thoughts of — say Lowell or Bryant — if the direction of revival is controlled *wholly* by our interest in naming American poets. But if we have been recently reading an account of Longfellow's memorable visit with Tennyson, then, owing to the influence of recency, our thought will be less likely to run from 'Longfellow' to the names of other American poets and more inclined to run toward the Tennyson visit; or if we have at some time visited 'The Longfellow House' in Cambridge, and if our visit had a marked emotional coloring, then, owing to the latter, our interest in naming poets gives way to thoughts of Longfellow's Cambridge home.

**Spontaneous Revival.** — We have just now enumerated some of the influences which determine the sequence of our imaginal and ideational processes. We have seen that contiguity, frequency, recency, and the rest are all grounds for the succession of particular mental states, say X or Y, in the wake of other particular mental states, A or B. The sequence is not lawless, wholly unpredictable. And yet, "it must be confessed', says James, 'that an immense number of terms in the linked chain of our representations fall outside of all assignable rule." Occasionally the sequence of mental phenomena seems to fly squarely in the face of what apparently are *pro tempore* the most potent influences; and not infrequently ideas and images emerge which are wholly unrelated to the preceding conscious waves and to the interests of the moment. These sudden and inexplicable revivals are supposed to be due to 'accidental alterations' in the cortical centers, 'accidental' in the sense that their causes are hidden to human knowledge. Among the influences that at times interrupt the normal functioning of the nervous system and, consequently, the operation of the usual laws of mental behavior, Thorndike enumerates 'fatigue, drugs, sickness, the decay of old age, shock, the chance variations of blood-pressure, and metabolism'.[1]

**Revival through Similarity.** — The perception or the thought of one of two objects which have one or more similar features is frequently followed by the thought of the other, even though they are unlike in other respects, and even though thoughts of the objects have never before occurred together. For example, it is a frequent occurrence that some feature or features of a strange face 'reminds' one of a face which is well known, or that some portion of a strange bit of landscape calls to mind a familiar one. The principle has a wide range of application. Similarity of any kind, real or imagined, between any two objects may form the link whereby one passes in thought from the one to the other. Thus, similarity in either color, taste, form, size, softness, hardness, ease, difficulty, position, beauty, ugliness, goodness, badness, fairness, unfairness, — in brief,

[1] *The Elements of Psychology*, 1905, p. 222.

any property or quality which can be attributed to or affirmed of any two objects may serve as the mental bridge from one to the other.

In the earlier text-books of psychology the usual way of accounting for transitions of this kind was to say that they fall under the law of association by similarity, the law that the consciousness of a given thing tends to revive images and ideas of things similar thereto. But now most authors explain all cases of associative revival by reference to the law of habit operating under the special conditions and limitations described in the foregoing paragraphs. And it is easy to see that what occurs in every case of so-called association by similarity is that some feature or features of the present object — whether perceived, imaged, or thought of — attains a certain prominence in consciousness, becomes 'the most interesting portion', to use James' phrase, and, breaking away from its immediate associates, gathers to itself certain of its former associates which combine therewith to form the new object of thought. To illustrate: suppose that while traveling in a strange region I come upon a towered church which immediately reminds me of a similar one I have known elsewhere. Now the explanation proposed by the earlier text-books is that the present edifice reminds me of the one known previously because of the similarity of the two. Not so. The two structures may be, in fact, similar; but their similarity is not, in itself, sufficient ground for the appearance of thoughts of the one whilst I am looking at or thinking of the other. The true explanation of such cases is that the thought of some feature of the present object revives certain of its earlier associates, which, in our illustration, are the tower, and other architectural features, the particular location, surroundings, and so on, of a formerly known church building.

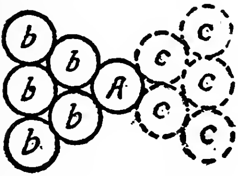


Fig. 33. "The full-drawn circles represent the elements of the present experience. Of these elements A attaches itself also to the system of elements represented by the dotted line circles. A, when taken with the circles b, b, b, constitutes the present experience; A, when taken with the circles c, c, c, constitutes the recalled experience. A is obviously the center of relations between the two systems." (Judd).

The accompanying figure (33) from Judd, together with his description, make plain the case of association through similarity. He writes, "The circle A represents a single feature of the [building] now seen; b, b, b, are the other features. In a past experience, A has been part of a system of features of which c, c, c, were the others. If A becomes the subject of special attention, it can revive the elements, c, c, c, and thus detach itself from b, b, b, the features of the present complex in which it stands."[1] Which of the 'interesting portion's' associates (i. e., which of A's earlier associates, shall, in a given case, be revived depends upon the influences already enumerated, namely, frequency, recency, context, dominant purpose, and so forth.

[1] JUDD, *Psychology*, 1907, 235.

It is true that in cases of revival through similarity, the reviving and the revived object are in some respect similar; but the revival does not occur because of our having first noted the similarity of the two objects. In fact, the similarity is observed, if at all, *after* the revival occurs, not before: so it cannot be maintained that the thought thereof causes us to think of the one object after thinking of the other. Psychologically, the fact of similarity has nothing whatever to do with the fact of revival. This latter depends wholly upon habit, as previously defined, and upon the varying influences of context, recency, vividness, and the other factors previously enumerated.

**Active and Passive Recall Distinguished.**—In revery, in day-dreaming, or when musing, the process of revival proceeds spontaneously, and the components of the conscious stream rise and disappear as if by chance. Strikingly different from this aimless flight of one conscious process after another is that restoration of images and ideas which is guided and controlled by a definite purpose. This latter process is ordinarily called voluntary, or active, recall, or perhaps better still — recollection. We have now to inquire in what respects it differs from passive, or involuntary, recall, or mere remembrance. We have to ask, that is, in what ways the presence of a definite purpose modifies the course of revival.

The mode in which a definitely conceived end operates in active revival is very clearly seen in one's effort to recall a forgotten name. Suppose, to fix our thoughts, that the purpose is to recall the name of a certain German philosopher. We know the name perfectly, but at the moment it refuses to come. How do we proceed to recall it? The answer is very simple. We dwell upon the revived images, thoughts, sensations, feelings, which we know are related to the forgotten name and neglect those which are not; and presently through an accumulation of resuscitative tendencies, or through the agency of some one which at the moment is especially effective for the revival of this particular name, our quest is successfully concluded. Thus, the philosopher whose name we are seeking, lectured at Heidelberg; his manner was oratorical; my friend H. carried a letter of introduction to him when he went to Germany; in appearance he resembled slightly a well-known American philosopher; one of his books was translated into English; an appreciation of his life and works recently appeared in a certain philosophical journal; I think his name begins with F; but it isn't Fichte; Fichte belongs to an earlier generation; the sound of 'r' occurs in the name; but it is not Franke, or Friedmann or Fritsch; it *is* Fischer — Kuno Fischer — Certainly! In all cases of voluntary recall we proceed in the same way. If it is the date of a given historical event which we are trying to recover, we fix its place by recalling its known associates, the names of persons living at the time, the dates of other historical events known to be related to the one whose date we are now seeking; or if it is a quotation, which we have heard a given speaker use with great effectiveness, we begin by thinking of the speaker, the occasion, the part of the address in which it occurred, its general purport, its length, whether prose or verse, the meter, the general 'feel' of the words — everything, in short, which is known to be in any way connected with the forgotten words. To repeat: in searching for forgotten items — forgotten names, dates, places, quotations — we run back and forth in thought over everything which we know to be related thereto. When the object of our search does finally burst forth it is due primarily to the resuscitative energy of these revived associates.

Now if we take the pains to run over and to dwell upon all the facts and circumstances which are in any way related to the lost name, (or date or quotation) it is likely to appear during the quest. Sometimes, however, the immediate outcome is failure. Now if, at some later time, the sought-for item leisurely rolls into consciousness, it is because, as we may suppose, the cortical processes, initiated during the active seeking, continued until they spread to those centers which are correlated with the object of our original search. In still other instances, our failure is permanent, and the explanation is again in terms of nervous process; that is, the failure on the mental side is due to the failure of the nervous processes which have been excited during the active search to shoot into and rouse the neural correlates of the forgotten fact.

**Memory and Imagery.** — We saw in our section on 'Individual Differences in Mental Imagery' (p. 146 ff) that there is an enormous variation in the wealth and character of the imagery of different individuals, that the remembering, thinking, planning of some persons consist of rich and varied imagery and that the imagery of others is poor, schematic, fleeting. It is unnecessary to repeat in this connection what was said there; but it is in place to emphasize the fact of variation as regards the part which imagery plays in the memory consciousness. Thus one person affirms that all his memories consist of images of the things remembered. His memory of a certain ball game, or of Irving's *Hamlet*, of a holiday parade, of the events of a thrilling story, consists wholly of images of the original experience. He would affirm — 'no images means, for me, no memory'. Another person will assure us that his memories seldom if ever consist of images of the remembered experiences; nevertheless, he regards them as perfectly trustworthy. He remembers that on a given occasion he saw Mr. Irving and Miss Terry in *Faust*, that on another he heard Melba, and that on still another he visited the museum at X. He may be able to give a minute description of the acting, the singing, and the museum; but he is unable to revive a single image of any of them. His recollection of these experiences consists wholly of verbal descriptions of them. His memory belongs to the verbal, or symbolic, type as described above. So, if it be asked, does the memory of a former experience always involve more or less of imagery of the experience? we must answer — for some persons, Yes; for others, No. Of course, between these extremes lie numberless gradations in reference to the place which images hold in individuals' memories of concrete experiences.

We have just referred to the vast differences among individuals in respect to the prominence of imagery in their memory experiences. A like wide range of variation is frequently observable in the place which images hold in a given individual's memories. Thus, a person whose memories ordinarily are replete with imagery often remarks that a particular one is devoid of imagery of any sort; or if present at all, it is fleeting and shadowy and consists merely of faint images of words seen or heard. To illustrate: if the reader, even though he be of the imaginal type, will run over some of his experiences of a decade ago — villages visited, persons seen, festal occasions, work performed—he will not unlikely find that his memory of some of them, while perfectly definite, is extremely colorless, and consists almost entirely of verbal signs. Thus the writer, who is of the imaginal type, recalls perfectly well that a few years ago he spent an hour or so in a certain village waiting for a train; but no images of the town arise. Its name awakens the bare thought — waited - there - for - train to N., and, at times, a feeble echo of the restlessness or impatience of the original experience, a kind of waiting-for-a-train uneasiness.

**Individual Differences in Memory.** — The term 'memory' is sometimes used popularly to refer either to the processes involved in acquiring knowledge or to the function whereby it is retained or to the power to recall it. Thus, there are in current use many such expressions as — receptive memory, retentive memory, ready memory, which, while they are descended from an obsolete psychology and so connote doctrines as to the nature of the mind which are no longer held, still do point to well attested facts in reference to individual differences in mental constitution. It may be remarked, in passing, that the language ordinarily employed to describe these differences is necessarily, in the present state of our knowledge, figurative to the last degree.

In the first place, minds differ enormously in respect to their receptiveness. At the one extreme are the plastic, impressionable minds which acquire knowledge with great ease and rapidity; at the other extreme are the stubborn, impervious, indurate minds. Between these extremes there are naturally many gradations of receptiveness. Minds differ also as regards their retentiveness. They are either strong or weak, tenacious or feeble. "Some minds," as James observes, "are like wax under a seal — no impression, however disconnected with others, is wiped out. Others, like a jelly, vibrate to every touch, but under usual conditions, retain no permanent mark." Between these extremes, we find numerous grades of retentiveness. In the third place, there are clearly marked individual variations in the readiness and accuracy with which experiences are recalled. One mind is quick, ready, definite; another is slow and indefinite.

An individual variation of the memory function, closely related to the one last mentioned, is in respect to what Stout calls its 'serviceableness', "the readiness with which what is relevant to the prevailing interest of the moment is reproduced."

" 'A memory may be extremely extensive', Stout continues, 'without being in this sense serviceable. Dominie Sampson's mind, as described by Scott, was like 'the magazine of a pawnbroker, stowed with goods of every description, but so cumbrously piled together, and in such total disorganization, that the owner can never lay his hands on any one article at the moment he has occasion for it.'"[1]

The obvious remedy (or preventive) for the confusion in the pawnshop and in the Dominie's mind alike is found in the organization, the classification of the contents thereof.

There are also certain well-known variations among these three functions themselves. The popular (and, in part, misleading) way of denoting them is to say that some persons learn easily, but soon forget; that others learn slowly, but retain long what is once learned; that still others possess retentive memories, but are exasperatingly slow and uncertain in recalling what they know. It should be remembered, of course, that these everyday expressions are not statements of laws as to the relations which obtain between one aspect of the memory function and another; they merely denote some of their frequently observed variations.

Again, common observation teaches that our memories are highly specialized functions, that a person may have a good memory for one class of objects, and poor for others. We have a striking instance of the specialization of the memory function in the case of the artist who could paint a portrait of a face seen but once, but could not learn the multiplication table; also in that of the chess player who played blindfolded several games of chess at

[1] *A Manual of Psychology*, 1899, p. 437.

the same time, but was unable to memorize a paragraph of prose; and again in the case of the musician who could reproduce difficult musical selections after hearing them once, but was unable to repeat the months of the year in their order. All these, to repeat, are illustrations of the fact that 'the memory', really consists of a multitude of specialized functions, and that in a given individual these may be highly developed in relative independence of one another, that memory for one class of objects or experiences may be good while for others it is poor, that there is no warrant for thinking that good memory for some things necessarily means good memory for all things.

Certain phenomena of mental disease, due to particular brain disorders, furnish further ground for thinking that different 'memories' exist in relative independence of one another. Thus it is found that in certain morbid mental states, memory for one class of facts is lost while for others it remains intact. Ribot quotes the case of a person who 'having received a blow on the head, lost all his knowledge of Greek, although his memory was otherwise unimpaired'; also that of a child who, after a period of unconsciousness due to a severe blow on the head, was found to have forgotten all that he had learned of music. Nothing else was lost. Other patients suffering from fatigue or brain injury often forget all proper names, even their own, yet retain other faculties intact. In other cases, they remember the use of common articles, as of food or furniture, but have forgotten all names. In still others, the patients understand spoken words, but written words mean nothing.

Cramming. — Among students and teachers considerable interest attaches to the question as to the value of cramming as a mode of study, meaning by 'cramming', "that way of preparing for examinations by committing 'points' to memory during a few hours or days of intense application immediately preceding the final ordeal, little or no work having been performed during the previous course of the term." (James). Perhaps a few students would be pleased to find sound arguments in support of this method of meeting college requirements, since it fits in so well with their own inclinations and with their own ideals of student life; that is, they would like to find ground for believing that it is just as profitable from the educational standpoint to spend the days and weeks of the term on matters far removed from class-room work, and then by heroic effort, during the examination period, make grades which will warrant their instructors in giving them term credit. Again, for a certain type of student there is something about the idea of cramming up for examinations and passing them that appeals to his love of display and to his natural desire to show his power, as he supposes, to do in a short time what requires weeks or months of diligent application on the part of ordinary mortals. He has a lofty contempt for the student who plods along day by day and who is unable to perform great feats on short notice.

But our smiles at the vanities of the imaginary student give way to soberness when such competent thinkers and scholars as Jevons, Verdon, Sully and others remind us that cramming has a good as well as a bad side. Jevons, for example, points to what he describes as, "a popular but wholly erroneous notion that what boys learn at school and college should be useful knowledge indelibly impressed upon the mind, so as to stay there all their lives." And Sully claims that "cramming has a value of its own" because what is thus learned is easily forgotten. And this, Sully maintains, "is a distinct advantage in many of the practical affairs of life; otherwise, the mind would be encumbered and our brain-powers far more narrowly limited than they now are. . . . . . Wherever the matter acquired is merely of temporary interest, the power of casting it off is a clear advantage." [1]

Now, it can not be doubted that, in practical affairs, men are occasionally required to memorize by intense application a mass of data that have no permanent value; they are useful merely for the occasion and had better be forgotten as soon as that is past. Carpenter illustrates this fact from the practice of the law. An attorney is sometimes required, he says, to work up by intense application the matters of fact involved in a suit which has only temporary interest. In such cases, it is clearly an advantage to be able to forget speedily the details of the matter, thus leaving the mind free for other problems and interests.

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[1] *The Human Mind*, vol. I, p. 350 f.

But this is not the whole story. The following sentences from James place the matter in a wholly different light. He writes: —

"In mental terms, the more other facts a fact is associated with in the mind the better possession of it our memory retains. Each of its associations becomes a hook to which it hangs, a means to fish it up by when sunk beneath the surface. Together, they form a network of attachments by which it is woven into the entire tissue of our thought. The secret of a good memory is thus the secret of forming multiple and diverse associations with every fact we care to retain. . . . . But things learned in a few hours, on one occasion, for one purpose, cannot possibly have formed many associations with other things in the mind. Their brain-processes are led into by few paths, and are relatively little liable to be awakened again. Speedy oblivion is the almost inevitable fate of all that is committed to memory in this simple way"[1] The retention of facts depends, in other words, upon their having formed 'multiple and diverse associations' with other facts; and since this, ordinarily, requires time, the ineffectiveness of cramming is evident if our purpose is to retain what we learn.

A highly instructive case is cited by Ribot from Abercrombie's *Intellectual Powers* of an actor who, in consequence of the sudden illness of another performer, was called upon to take the latter's 'part':—

"He acquired it in a very short time, and went through with it with perfect accuracy, but immediately after the performance forgot every word of it. Characters which he has acquired in a more deliberate manner he never forgets, but can perform them at any time without a moment's preparation; but as regards the character now mentioned there was the further and very singular fact that although he has repeatedly performed it since that time, he has been

[1] *Principles of Psychology*, vol. I, p. 662 f.

obliged each time to prepare it anew, and has never acquired in regard to it that facility which is familiar to him in other instances."

It would be difficult to find a more impressive illustration of the futility of cramming as a mode of study, provided, permanence of attainment is the chief purpose. It illustrates, in the first place, the proverb, 'quickly won, quickly lost'; and, secondly, it suggests the curious fact, if fact it be, that memorizing a thing by the method of intense application entails a hindrance to its ever becoming a permanent possession, even though more rational methods be employed in relearning it.

Were this the proper place, it would be worth while to follow out the educational implications of the two views of cramming just outlined. We might inquire, for example, to what extent the theory of formal discipline underlies the teachings of those who defend it; also what, if any, ground can be found for the view that in our school studies method is everything and that matter is relatively unimportant. But these inquiries would take us too far afield. So far as the educational issues are concerned, they may be summed up in Titchener's words: 'Cramming is bad, if you want to remember, good, if you want to forget, what you have learned'.[1]

**Prodigious Memories.**—This topic can hardly be accounted complete until it includes one or two specimens of the olden time stories of prodigious memories. The earlier generations of teachers of 'Mental Philosophy' probably employed them as models of scholarly attainment for their more ambi-

[1] *A Primer of Psychology,* 1907, p. 197.

15

tious pupils; and also, one may fancy, to humble the pride of the haughty collegians of their day.

It is interesting to the student of the history of education to observe that most of the stories of marvelous memories, as told in the older books on psychology, are accounts of prodigious feats of remembering words. To this class belongs the oft quoted passage from Seneca's *Declamations*, wherein he says that at one time he was able to repeat two thousand names read to him in the order in which they had been spoken; and that on one occasion, when at his studies, he repeated in reverse order two hundred disconnected verses which had been recited by other pupils at the school. Likewise, the philosopher Leibnitz's ability to repeat the whole of the Aeneid was due chiefly to his preternatural word memory. More remarkable still is the account given first by Muretus and quoted here from Hamilton's *Lectures on Metaphysics*[1] of the word memory possessed by a certain Corsican youth of the sixteenth century, Guilio Guidi by name — Guidi della gran memoria — the people called him. Guidi, as the story runs, at Muretus' request gave on a certain occasion a specimen of his power "before a considerable party of distinguished auditors." The party assembled, Muretus began to dictate words, Latin, Greek, barbarous, significant and non-significant, disjointed and connected until he wearied himself, the young man who wrote them down and the audience who were present. "All save the Corsican were marvelously tired," says Muretus. Then, continues the account, "vidi facinus mirificissimum, the youth repeated the whole list of words, in the same order in which they had ben delivered, without the slightest hesitation; then commencing from the last, he repeated them backwards till he came to the first; then again so that he spoke the first, the third, the fifth and so on in any order that was asked." Hamilton admits that Muretus' "trustworthiness was not quite as transcendent as his genius;" but concerning this particular record, he found evidence which convinced him of the truth of the account. We are not concerned here partic-

[1] *Lectures on Metaphysics*, Lecture XXX.

ularly about the absolute truthfulness of the story; we may, however, without being over credulous, believe that there was a sixteenth century Corsican youth greatly famed for his preternatural word memory; we are chiefly interested in the story as a record of the prodigious capacity for a memory feat of a special kind.

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# CHAPTER X

## IMAGINATION

Definition. — It will be well at the outset to clear our minds of two widespread misconceptions regarding the nature of the Imagination. One of these is that imagination is a special compartment of the mind in which imagining occurs. According to the other, the imagination is a kind of instrument which the mind uses in imagining in much the same way that a weaver uses a loom in weaving rugs, or a sculptor his mallet and chisel in cutting marble. Now, we have seen elsewhere, that psychologists no longer speak of the mind as composed of compartments, nor do they think of it as some sort of reigning power within us which works with certain implements called memory, imagination, judgment, and the like. Instead of describing imagination in this figurative way, let us define it broadly as that kind of centrally initiated mental activity whereby our images of objects, in respect to their nature and their relations, undergo changes. The nature of this kind of mental activity can be made clearer by considering certain of its typical forms.

Types of Imaginative Activity. — There is a widespread notion that imaginative activity is an altogether orderless process. It is evident on reflection, however, that it ordinarily follows certain types, or patterns, some of which we shall now describe.

Perhaps the most common class of imaginative constructions is that in which objects as wholes, or some parts or qualities or attributes thereof, are isolated, then transferred to and combined with other objects or attributes or situations. The process is sometimes described as one of separation and combination. Castles in the air, images of one's self occupying a place of power and authority, the Chimera, the centaur and the Harpies of Greek mythology, a mermaid, the winged fairies and the fairly-land, are the stock examples of this kind of imaginative constructions.

A special form of the type of imaginative activity just mentioned consists in comparing ideal to physical objects, particularly in ascribing to ideal objects patterns or orders of arrangement or occurrence, observed in physical objects, or in the symbolic representation of the former. Prosaic examples are — likening mental development to the growth of a plant, or the structure of human society to that of a complex animal organism. Many of the creations of poetic fancy are clearly due to this type of imaginative procedure. For example, 'Justice' is pictured as blindfolded and bearing a sword and balanced scales; a human figure holding aloft a lighted torch is 'Liberty Enlightening the World'; a presidential candidate is 'a plumed knight throwing his shining lance full and fair, etc.'; the soul of Milton was 'like a star and dwelt apart'.

The form of imaginative activity just described shades gradually into the purely æsthetic imagination and the creative genius of the artist. The allegories, parables, fables, metaphors, personifications which abound in the literatures of all peoples, the works of sculptors and painters which symbolize human qualities, fancies, ideals, aspirations and achievements, the creations of the masters in the world of music, are familiar illustrations of this form of imaginative construction.

In another kind of imaginative activity the problem is to complete a whole, some of its parts being given. Striking instances of this type are seen in the artist's restoration of the lost fragments of a Grecian statue, in the paleographer's reproduction of the obliterated portions of an ancient inscription, in the archæologist's conjectures as to the use of implements found in the ruins of the dwelling places of prehistoric man, and in the paleontologist's reconstruction of an extinct animal form from a few fragments of discovered bones.

Still other types are those in which we imagine changes in the size, duration, or intensity of perceived or imaged objects. The giants and pygmies of Gulliver's Travels are familiar examples of the first sort of imaginative changes, i. e., in respect to size. Impressive pictures of the prolongation of certain kinds of experiences are given in the mediæval portrayal of the never ending torture of the wicked (duration). The intensity of our experiences is readily susceptible to imaginary change. For instance, we may easily picture the brightness of the moon much greater than we have ever known it, and that of the brightest sun fading into blackness.

**The Limits of Imagination.**—To the popular mind, the term 'creations of the imagination' means, on the one hand, weird and fantastic mental pictures, the phantoms of heat oppressed brains, romances, delusions, and all manner of unrealities; and on the other, it means the great creations of artistic genius, which far surpass the powers of ordinary mortals. From this conception of the nature of imagination it is only a step to the belief that there is a touch of the miraculous in its works, that imagination in some measure transcends the limits of the world of experience and in fact creates things wholly new to earth and sky.

Over against this tendency to ascribe somewhat of the supernatural to the imagination stand the sobering words of Locke that, "the mind can frame unto itself no one new simple idea;" and those of Sully that, "all imaginative activity is limited by experience; . . . . there can be no such thing as a perfectly new creation." Imagination is not a process of constructing new forms out of new elements of its own creation. Its work consists in rearranging and recasting perceived and imaged objects. As the builder requires raw materials in the form of bricks and stone and mortar, so the imagination for its constructions requires a fund of raw materials in the form of perceptual and imaginal experiences. Even the genius of a Milton or a Mozart or a Shakespeare in no case transcends the limits of experience. The characteristics of Milton's *Satan*, for example, are only the traits of ordinary mortals rearranged, intensified, and magnified. Milton's genius consisted not in imagining absolutely new qualities, emotions, sentiments, motives, desires, but in doing marvelous things with those which everyday experience and observation furnishes.

We have just pointed out that the raw materials, the elements of our imaginative constructions, are furnished by the experiences of our daily life. It is in order to observe next that the patterns or models which control imaginative activities are also given in experience. For example, the most common pattern of imaginative construction, namely, that which consists essentially in the double process of isolating one object or quality and combining it with another has countless prototypes in the experience of everyday life. All about us from early infancy we see objects and their parts detached and placed in new relations or new combinations. So, when later we construct imaginatively a Cerberus, or a griffin, we merely copy a method of dealing with objects which is already familiar. So also when we set out with a fragment or portion of a statue or inscription or extinct animal form and proceed to reconstruct it imaginatively, our method is the same as that of the boy who finds a detached part of an old machine and sets out to find the lost parts or to think what the original was like. And in those activities which consist in imaginative changes in the size or intensity or duration of objects, the pattern is very obviously derived from experience. Increase and decrease of objects in respect to these three attributes are constantly going on all about us; and the observation of these changes doubtless furnishes the pattern for this class of imaginative constructions.

**Passive and Active Imagination.** — It is customary to distinguish 'passive' from 'active' imagination. In the former, the images appear spontaneously, run their course freely, without conscious control, and imaginal changes and combinations arise capriciously as in day-dreaming, in building air-castles, in the fancies of childhood or when one dreamily follows the description of a bit of natural scenery, or the incidents of a story. The distinguishing mark of the 'active', or creative imagination is that it is controlled and guided by a definite purpose. When a sculptor sets to work to frame an ideal image of Mars, or the astronomer to foretell the times and places at which an approaching comet will be visible, or the inventor to design a vehicle propelled by steam, he exercises what is commonly called 'active' imagination. And the imaginative construction of the artist or scientist or inventor consists in the selection and modification of those recurring images that accord with his general purpose and the rejection of those that do not.

It is thus clear that active imagination bears a close resemblance to the process of active recall as described in the preceding chapter (p. 214 f). Both processes are guided by a definite purpose; in both the persistence of the purpose determines, for the time being, and in some degree, the character of the recurring images, and in both cases we have the selection from the train of revived images those that are congruous with our general purpose and the rejection of those that are not. Moreover, the success of a piece of creative imagination, like that of the effort to recall a forgotten name, depends upon the revival, as occasion requires, of images that are appropriate to the case in hand. This is popularly expressed by saying that creative imagination, as regards a given kind of objects, requires a mind richly furnished with images relevant thereto, and that these shall be easily revivable.

**The Beginnings of Imagination.** — In one's study of the early stages of the development of the imaginative activity it is impossible to separate images of imagination from memory-images or from mental images, in the broad meaning. One cannot at first draw sharp lines and say — here we have the one, there another. Nor is it true, as some writers believe, that the child must have a store of mental images before the imagination can 'take flight', if by 'store of mental images', is meant a stock of definite, literal copies which might be inventoried as raw material which is susceptible of imaginative transformation. The truth is rather that the various kinds of images are inextricably interwoven in all early imaging. And yet imagination, in the meaning already stated, is involved in certain kinds of infant behavior, namely (1) in expressions of desire; (2) in practical devices to bring about given ends; (3) in imitative play; (4) in free, uncontrolled play; and our purpose in the following paragraphs is to indicate the part it plays therein.

**Expressions of Desire Involving Imagination.** — The child's first desires probably are for the repetition of pleasurable experiences which he recalls. But there comes a time — early in the second year, as a rule — when he begins to picture *new* objects and new relations of objects which he desires. One observer reports, for example, that his subject in his eighteenth month would pat on the floor and cry 'dee' when he wanted a given article placed on the floor in a certain place where he could get hold of it. Again, during his thirty-first month, the same child frequently imaged huge Os which he wanted drawn for him, expressing his desire for them by stretching his arms far apart and above his head. Now these simple expressions involve something besides revived images. In the first instance, the child imagined the position of the toys changed from the shelf out of his reach to a particular place on the floor (or on a chair) where he could reach them; in the second, he imagined more wonderful Os than he had ever seen.

Imagination in Practical Devices.—Imagination appears very early in the child's practical devices to gain given ends. For instance, early in his fifteenth month, a certain child was observed to push a child's chair to a table, then climb up in the chair in order to reach spoons, cups, and other table-ware. This action, while probably imitative in some degree was not wholly so. The child doubtless had a lively imagination of being engaged with the interesting table-ware when he started to the table with the chair. A little later, one may observe entirely original devices in which the child shows initiative, in which he acts out a new image. For example, during a rain-storm, a certain child, eighteen months old, went about the room closing the inside window shutters to keep out the storm, as he supposed. In the same child's twenty-fifth month, in his efforts to get a kitten to eat a piece of toast, which was lying on a table, he employed the unusual device of lifting the kitten to the table, and then rubbed its nose over the toast instead of taking the bread and giving it to his pet as an older child would have done.

Imitative Play. — How much of the baby's imitative play is an effort literally to copy his models? how much is free realization of an idea which has been suggested by them? One cannot say definitely; but it is safe to say that few children at play are such slavish copiers as not to transform, in some measure, the things they imitate. For instance, in the well-known doll-play of little children, this transforming tendency is clearly present. Almost any manageable thing — a bit of rag, a stick, a few straws — may serve as a doll which is fed, dressed, punished, put to bed, doctored, without any thought of the reality or unreality of the imaged actions. In doll-play the child moves in a world which is so completely fanciful in character that he fails to note what the older person calls its incongruities.

Constructive Imagination in free, uncontrolled Play. — Every observer of children knows how in their play they represent all sorts of objects and scenes by means of simple articles like blocks, pebbles, buttons, sticks; and also how readily the child-mind transforms such articles into things of life and action — horses, cattle, soldiers, locomotives — and how they are marshaled to represent scenes which have greatly impressed the child, and which he wishes to repeat. For instance, the child goes to church and upon his return home, plays 'church', using chairs, tables, blocks — whatever comes to hand to represent those features of the church service which impressed themselves upon him. In like manner, school, keeping store, a circus parade, are reproduced in their most striking features by means of such articles as the child can command. As one author remarks, the blocks or chairs or shells form the one bit of necessary substantiality from which the child fancy takes its flight, and around which it builds its imaginary scenes.

A notable difference between the baby's imaginal consciousness and the adult's may be noted in passing, namely, the absence in the former of what are called 'trains of imagery'. In the developed mind, most of the images that arise in consciousness are aroused or suggested, by immediately preceding images. An image appears in consciousness, the first calls up a second, the second a third, the second and third may revive new ones, and we have what we call a train of imagery, often uninterrupted by outside stimuli. But trains of imagery are unknown, probably, to the child under two. He hears the word 'ball', or 'clock', or 'hat', the image of the object comes to his mind and there the process ends, unless the child happens to want the object named; while in the mature mind any one of these words may very easily start a train of images.

Individual Differences in Imagination.— In our chapter on Mental Images we saw that individuals may be classified roughly according to the differences in the sensory basis, or source, of their favorite or predominant forms of imagery. We may also classify individuals in respect to the variations in their ability to manipulate imaginatively different kinds of objects. Thus one person possesses unusual ability for imaging mechanical devices of various sorts; a second, most easily images the conduct and emotional reactions of human beings; while a third shows greatest facility in imaging processes and relations in nature. For example, an Edison or a Fulton possesses highly developed powers of imaging in the field of mechanical invention; a Shakespeare or a Gladstone, in that of human nature and politics; a Darwin or a Tyndall, in respect to the phenomena of the physical world; and it seems not unreasonable to suppose that similar differences exist among people generally, but in the latter case they are not so conspicuous as they often are when one is comparing the achievements of great men.

The causes of individual differences of this kind cannot at present be stated with even a semblance of scientific precision or completeness. It is popularly believed that they, like others, are due in part to differences in native endowment, or original nature, in part to the varying educational influences of childhood, and partly to the special requirements of chosen occupations. And so far, the popular view is doubtless correct. For example, the difference between the imaginative achievements of the poet and the soldier, or between those of the musician and those of the man of science, is doubtless due partly to differences in their inherited mental constitutions. It is hardly conceivable that environmental influences alone could have produced the differences between the imaginative powers of Tennyson and Wellington, or Bismarck and Schiller; and it is past thinking that Newton or Kant inherited gifts of imaginative creation comparable to those of Shelley or Beethoven, comparable, that is, as regards the character of the objects in respect to which their imaginative processes moved most freely.[1]

Common opinion is right also in attributing individual differences in imagination in part to differences in home and school education. To take an extreme case — a child whose school days are spent in studying the behavior of plants and animals, in poring over stories of travel and adventure, in rehearsing historical narratives, in following the visions of the poets, will, other things equal, develop imaginative powers which far surpass those of a child whose days are spent in memorizing meaningless symbols. This is only to say that the imaging function grows by exercise, and that when the exercise is lacking, the function atrophies. Special training or exercise also produces characteristic differences in imagination. Thus, a child's ability to imagine new combinations of musical tones, to design new forms for moulding clay, to picture strange peoples, their customs and institutions, depends upon imaginative training in these subjects. The child's imagination takes character from the materials in which it is exercised.

[1] It would be interesting to inquire concerning the relationship between 'imaginal type' and the ability 'to manipulate imaginatively' different classes of objects.

It is merely a further application of the principle just stated to say that individual differences in imagination depend partly upon differences in the imaginative requirements of different occupations. The oculist's imagination differs from the architect's, the naval officer's from the pianist's, the physicist's from the actor's, simply because the stocks of images with which each habitually works differ, and because these different occupations require different imaginative habits.

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## CHAPTER XI

### THOUGHT AND THE THOUGHT PROCESSES

**The General Nature of Thinking.** — We cannot begin our study of thought and the thought processes better than with the following quotation from James:—

"As our hands may hold a bit of wood and a knife, and yet do naught with either; so our mind may simply be aware of a thing's existence, and yet neither attend to it nor discriminate it, neither locate nor count nor compare . . . . nor recognize it articulately as having been met before. At the same time we know that, instead of staring at it in this entranced and senseless way, we may rally our activity in a moment, and locate, class, compare, count, and judge it. . . . . . The result of the thought's operating on the data given to sense is to transform the order in which experience *comes* into an entirely different order, that of the *conceived* world.[1]

Our account of the general nature of thinking will be little more than an emphasis of the several features of this quotation.

In the first place, we are to conceive of the thought processes as belonging in a special sense to the mind's own operations. If we say that our sense-experiences, together with the memories and imaginations that are built up out of them, are, in a way, forced upon us or arise in response to our environmental influences, then by way of contrast we may

[1] *Principles of Psychology*, Vol. I, p. 481 f.

say that the thought processes—our judgments, our comparisons, our analyses, and our classifications — belong in a special manner to the mind's own activities; thoughts seem to be 'mind born', to be experiences which do not originate in the direct influences of our environment. To illustrate: the sensations, red, blue, sour, warmth, fragrant, and so on, are caused by external objects acting upon the sense-organs; but the thought that these sensations differ is a distinctively mental addition to the bare sensory experiences. Again, a child's perceptions of a fish, a sparrow, and a gorilla, as individual objects, since they are dependent upon the stimulation of the sense-organs, belong, in the broad classification just indicated, to the sensory field; but to know these objects as vertebrates involves a distinctively mental addition to the bare perceptions—the thought, namely, that despite their conspicuous dissimilarities they are alike in having a backbone of bony vertebræ. The thought of this similarity amidst enormous differences was clearly, in the first instance at any rate, a 'mind born' process, not something impressed from without.

In the second place, we are to conceive of thought as a mental playing with, an active manipulation of the materials given in sensation, feeling, perception, and memory. Its chief function is not to yield new sensations, new feelings, new memories, but rather to work over the materials already in stock, to discover their relations, to classify, and to render judgments concerning them. Stated otherwise, thought's chief function is to transform "the order of nature, which', as Mill writes, 'as perceived at a first glance, presents at every instant a chaos followed by another chaos," into an orderly world of relations, to ascertain differences and likenesses where they are at first hidden, to search out elements and essential features, to number and group and classify the materials given in sensation and memory. To take a simple illustration: contrast the world which the child of six knows and lives in with that of an educated adult. The former knows nothing of the distinctions of vegetable, animal, and mineral kingdoms, of physical and psychical, of chemical and physical changes, of metals and non-metals, of stars and planets, of consonants and vowels, of indicative and subjunctive; these and the numberless distinctions which are made in the process of education are highly artificial, are not given in the 'order of nature', and are, in the main, the results of the thought processes; and they are, of course, the rarest products, and, for our intellectual life, the most important creations of our mental activities. In a word, to think is to manipulate, to operate on, the data already in store. Thinking in its completest forms yields a new fund of experiences which we know by the names of comparisons, analyses, classifications, abstractions, judgments, and inferences; and these comparisons, analyses, classifications, etc., together make up the transformations which thought works in the materials that originate in sensations and feelings.

THOUGHT PROCESSES AS FUNCTIONS. — A thought process, like every other cognitive process, may be studied from either the structural or the functional point of view; that is, we may study the process as it is in itself, as an item in the stream of consciousness, or we may fix attention upon its function, upon its meaning, the object or objects which it designates. The difference between these two ways of regarding a psychical process may be emphasized by recalling a difference in point of view which was indicated in our earlier chapters. It was there seen that from one point of view we may regard sensations, e. g., of redness, sweetness, warmth, and the like, as conscious processes, as mental existences; and that from another point of view, we may regard them as consciousnesses of the qualities of objects, as the raw material of our world of knowledge. It was said also that the psychologist may limit his task to the analysis and description of these sensory experiences as items in the conscious stream and to the discovery and formulation of the laws of their combination with other conscious processes; he may think only of the sensory processes as they are in themselves and of their interrelations. He may, however, from another point of view, be interested primarily in the fact that sensations constitute the raw material out of which our knowledge of the external world is constructed and in the functions which the several kinds of sensations thus serve. In short, the distinction there drawn was between sensations as items of the stream of consciousness and sensations as acquaintance with the qualities of objects. Similarly, we may consider the structure of the thought processes, what they are like as phenomena of consciousness, or we may consider their meanings, their objective references. In the present study we shall be concerned chiefly with the thought processes as functions, and only incidentally with their structure.

**The Thought Processes.** — From our present point of view we may distinguish broadly two classes of thought processes, or functions. To the first class, belong those mental activities which consist essentially in designating, pointing out, objects; to the second class, belong those processes which consist essentially in designating relations between objects. Stated otherwise, we may think of, mentally point toward, mean, either material things, or our own or others' consciousnesses; these mental designations, or meanings, we may call 'thoughts of'. We may also think of a thing's relations to other things: these thoughts we may call 'thoughts about'. In short, all thoughts are either thoughts *of* or thoughts *about*. The thought of, the bare designation of an object, we shall call *Ideation*, or *Conception;* the thought about a thing, which as we have seen, is the same as the thought of its relation or relations to other things, we may call *Judgment*.

In the remaining pages of the present chapter we shall first study Ideation in the broad meaning just indicated, and also Abstraction, a special form of the ideating process. Next we shall explain a little farther the nature of Judgment, after which Reasoning, the process in which thought reaches its clearest and fullest expression, shall have a few pages. In the next chapter we shall consider certain of the more complicated thought processes.

**Thought as Ideation.** — In our present meaning of the term, to think *of* anything is to refer to it, to designate it, to mean it. Thus we say we are thinking of the ships at sea, or of the effects of a heavy frost on the budding fruit, or of the relative value of two college studies. We do not mean to say *what* we are thinking about the ships or the frost effects or the values of the college studies; we mean merely to convey the information that these things are, at the present moment, subjects under consideration. So, in this sense of the term, to think of a thing is to designate it, to select it from among all other possible subjects as a topic of discourse or reflection. A thought *of* is a reference *to*, the identification or designation of, a thing or group of things.

The terms idea and ideate are frequently used as the equivalents of thought and think, in the present meaning of the two latter terms. But the student should observe that, in the present connection, to think of, or ideate, a thing does *not* mean to form a mental image of it. The mental process is merely one of referring to, of designating, an object. Thought and ideate, as here used, are equivalent to James' term 'conception' in the sentence, "The function by which we . . . . identify a numerically distinct and permanent subject of discourse is called conception."

The expression 'thought of' this and that seems to imply that the thought is always one thing and the thing thought *of* is always another. As a rule, it is true, the thought and the object of thought are, for the common sense point of view, two different things; e. g., the thought of the Parthenon, the act of mentally designating the Grecian temple is one thing, the temple itself, another. Not infrequently, however, the 'thought of the object' and the 'object of thought' are one and the same thing. Thus in the sentence, 'I am thinking of the difference in meaning between the two words 'famous' and 'notorious', my thought *is* the difference, as I understand it; the 'thought' and 'the object of thought' are one and the same. But, to repeat, to think of a thing, in its primary sense, means merely to refer to it, to point it out, to identify it.

**Thought as Abstraction.** — The term 'abstraction' has three well-defined meanings in psychology. Sometimes it means attention to some feature, quality, or element of a complex object, as when one examines the form of a leaf and neglects for the time being its color, size, venation, and functions; or when one centers attention on Hamlet's rash and impetuous behavior at Ophelia's grave and forgets his usual irresoluteness.

At other times, and more frequently, perhaps, abstraction means the thought of a feature or quality which is common to a group or class of objects. The thoughts of the brilliancy of diamonds or of the humor or pathos of Dickens' novels or of the courage of Roman soldiers may serve as illustrations of the second meaning of abstraction.

At still other times, abstraction means the thought of general or universal qualities, attributes, conditions. Examples are, thoughts of brightness, sourness, courage, motion, in general, i. e., without reference to any one of the multitude of individual things that may be described as bright, sour, moving, courageous. Usually the context will enable the student to tell in which of the three senses the term is used, whether it means the thought of a particular part of a complex, or the thought of a property common to a group of objects, or of an abstract universal.

**How Abstract Meanings Arise.** — Abstraction, in in the first of the senses just mentioned, as a simple process of isolating some feature of a complex, e. g., the tones of the clarionet in an orchestral performance, is essentially the same as the attentive process, so-called. To abstract a feature or aspect of a given object, event, or situation is, in this sense, to attend to it; and the conditions of abstraction and attention are the same. Now the conditions, or determinants, of attention are, as we have seen in an earlier section, that the object shall possess either a certain intensity or a certain quality or suddenness or novelty, or shall be repeated a number of times, or shall be congruous with one's present interests whether instinctive or acquired. Thus loud sounds, bright colors, bitter tastes, novel or suddenly appearing impressions of all kinds attract or even compel attention. Likewise, oft repeated stimuli force themselves to the focus of consciousness. And everyday experience furnishes multitudes of illustrations of the tendency of impressions that are congruous with one's present consciousness to attain prominence in the conscious field. Shells or beach pebbles that entirely escape the notice of most pleasure seekers, stand out like brilliants to the boy who is hunting that particular kind and whose mind is full of their images.

It is not difficult to account for abstractions of the second class, i. e., to understand how we come to think of a given attribute as common to a group of objects, e. g., of brightness as a property of the stars or of ferocity as a characteristic of lions. All that is required is a multitude of experiences with members of the group, that these experiences shall possess a high degree of uniformity, and that the conditions of the experiences shall be such that the particular feature shall frequently attain vividness in our consciousness. For example, our idea of ferocity as a characteristic of lions has grown up very easily out of a practically uniform racial experience with these animals. As we say in everyday speech, experience has taught that lions, as a class, are ferocious. In the same way, our knowledge of the various common properties of the multitudes of groups of objects in our environment has come into being.

The third kind of abstractions described above, the thoughts, e. g., of brightness, of color, of triangle, of stature, of ferocity, of motion, of direction, which are not of any particular brightness, color, triangle, stature, ferocity, motion or direction, while not mysterious affairs, belong to a higher stage of mental development and are evidently rarer processes than abstraction in the two senses just mentioned.

If the question concerning the original formation of abstractions of this last mentioned class relates to individual development, i. e., how does a child that is born into a community where abstractions of this kind are the common property of all its members ever come to think of motion, color, stature, direction, etc., which are no particular motions, colors, statures, or directions, the answer would be that these thoughts are absorbed along with the words which name them. They are parts of such a child's intellectual inheritance, and he gets possession of them as rapidly as he can acquire the intelligent use of the words which serve as their vehicles. At first, to be sure, the pupil over his geometry or his physics lesson thinks of particular triangles and of particular instances of motion, just as at first the word 'cat' or 'horse' means, to the child, some particular cat or horse. But in time, the pupil acquires the ability to think of triangle and motion without thinking of particular triangles or motions.

If, however, our question is, how did the human race, or certain portions of it, come into possession of such a wealth of 'abstract general ideas,' like those expressed by the words color, triangle, animal, plant, mineral, sound, motion, velocity—if it is asked what were the experiences out of which these thoughts rolled, so to say, and who were the geniuses in whose minds they first arose, and who fixed them and made them permanent additions to the intellectual wealth of the race by naming them? then we must say that the answers are largely hidden away in the long ages of forgotten racial experience. We say 'are largely', not wholly, hidden, since modern research furnishes a plausible account of the origin of many of our abstract meanings.

The method most widely employed in the attempt to get light on the history of these meanings, and indeed, in the historical study of all meanings, may be called the 'linguistic'. That is, an effort is made to trace the history of meanings by tracing the history of the verbal forms which serve as their vehicles. Titchener gives a particularly good illustration, which is here quoted in part, of the use of this method:

"If the logician were speaking of the relation which the concept 'whiteness' bears to the substance 'snow', he would call it an *attribute* of that substance. An attribute is a characteristic or property or mark of a substance. How has the concept [the abstract idea, 'attribute'] been formed?

"We find in Latin the word *tribus* which means 'tribe', a community, a society of men. In Latin we also find the verb *tribuo* 'to assign' or 'give'; and the past participle of this is kept in the English *tribute*. 'Tribute' means 'what is done by the tribe'; and 'what is done by the tribe' is to pay for protection, to give or bestow something upon a chieftain or a more powerful tribe in return for favours received. The special meaning retained in 'tribute' has become a general meaning ('to give,' simply) in the verb *tribuo*. — Finally, from *tribuo* comes 'attribute', that which is assigned or granted to something. It is a long road that leads from the village community through the assessment of the community to the logical characteristic but it is without doubt the road that this concept travelled."[1]

**Thought as Judgment.** — We have defined Judgment as the thought of a relation between or among objects. In this case, the thought of relationship is the essential, the characteristic mark of the judging process. Now this definition may seem open to the criticism that it makes of judgment the affirmation of a relation in which nothing is related, the designation of the keystone of an arch which has not been constructed, which, of course, is an absurdity. The answer to this possible objection is that, in our view, the judgment of relation implies the related things, the parts of the arch which are held in place by the keystone, and that, to continue the figure, judgment is a process of designating, pointing to the keystone, and to the function it performs. Or, put in another way, a judgment is a thought-of-a-relation-between-

[1] *Primer of Psychology*, 1907, p. 224.

objects. It may be remarked, further, that the foregoing definition is obviously a departure from certain current teaching which makes the consciousness of wholeness (which, in our view, is only one form or instance of judgment) the distinguishing mark of the judging process.

Not infrequently, in the author's experience, students are puzzled by the expression, 'the thought of a thing's relations to other things'. This difficulty, when it becomes articulate, assumes the form, 'what is it to think of relations between objects? give us some examples.' It seems desirable, therefore, to try to clear away this obstacle at the outset.

Two simple illustrations will suffice. Suppose one is thinking of a boulder's 'relations' to other things. To assert that the boulder lies to the right or left, east or west, above or below, inside or outside, of some other specified thing, that it is east of a given oak tree and inside an iron fence, is to utter judgments regarding its *spatial* relations. Temporally regarded, one may continue, the boulder in its present form antedates certain geologic events and is subsequent to certain others. Again, one is thinking of *causal* relations when one affirms that the boulder's present form and position are due to glacial action. One may designate its further relations by noting that it is composed of certain substances and belongs to such and such a class of rocks. These may serve as examples of statements regarding the physical relations in which objects stand to one another. We also speak of 'human relations', the relations in which human beings stand to one another, e. g., parent and child, principal and agent, author and reader, judge and jury, general and army, class and pupil, society and individual, and so on.

**Judgment as Synthesis.** — In a certain sense, every judgment is a mental synthesis, a process of mentally uniting, or combining, two or more of our ideas or meanings. This is true even of the analytic judgments which consist in breaking up a complex whole into a number of distinguishable parts. Thus in the judgments whereby we designate the sensory qualities of a lemon as yellowish in color, oblong in shape, sourish in taste, or as soft or hard, rough or smooth, fragrant or odorless, we have a mental union of the idea lemon and its several properties. It is true even of the so-called negative judgments which deny the objective connection of objects no less than of the affirmative ones; both involve the mental togetherness of their terms. For example, in order to judge, 'iron is not a precious metal' the ideas 'iron' and 'precious metal' must both be together in consciousness, in the same way that the terms 'iron' and 'useful metal' are together in the judgment — 'iron is a useful metal'. The only difference is that a relationship is affirmed in the one case and denied in the other. Our present concern, however, is not with judgment in this meaning, but rather with the fact that multitudes of judgments are thoughts of the union or the connection of given objects, with the fact that their purpose or function is to designate the real or objective union of the things in reference to which they are rendered.

The practically most important classes of judgments in this meaning are (1) judgments of cause and effect, (2) of substance and attribute, (3) of spatial and temporal relations. We shall give a few examples of each class.

Judgments of Objective Relations.—Judgments that given things are the causes of other given things occupy a large place in our thinking from early childhood.

While we are not concerned here to trace the development of the scientific idea of causation, it may be in place to remark that the psychological beginnings of causal judgments are found probably in the child's observations of the results of his own activities. Thus, in manipulating toys, the child soon observes a relationship between certain of his own actions and particular changes in the toys — say changes of position or in sounds produced. Gradually thereafter, the notion emerges that every change in both the material and mental worlds has a cause; and in time, thoughts of, and inquiries concerning, the cause and effect relationship come to hold a large place in one's thinking.

A second large class of judgments of objective connection pertain to the substance-attribute relationship. The common words bright, dim, warm, cold, sweet, bitter, hard, soft, rough, smooth, and the like form the predicates of this class of judgments. Needless to say, they make their appearance early and, taken together, they constitute probably the largest single group of terms employed in the average person's thinking.

Judgments that designate the temporal and spatial relations of objects are expressed by such adverbs as, — before, antecedent, after, subsequent, earlier, later, coincidently, concurrently, and the like . . . . The words above, below, inside, outside, to the right, to the left, upon, underneath, opposite, same (of direction), will serve as illustrations of the terms employed in judgments of spatial relation.

It may help us to realize how large a place judgments of cause and effect, of substance and attribute, and of temporal and spatial relations occupy in our thinking to recall that many of our text-books are made up chiefly of these classes of judgments. For example, a text in political history consists of statements of when and where given historical events occurred, and, in some cases, consideration of their underlying causes. Books on biology describe the properties, habitats, and the grounds of the behavior of living things. A treatise on psychology consists mainly, of judgments in respect to the properties, the temporal sequence, and the causal relations of mental processes. In a word, all our school subjects, in so far as they are scientific in aim, are concerned with the temporal, spatial, attributive, and causal relations of their respective subject matters; they purport to be answers to the questions — what? when? where? why?

**Relation of Ideation and Judgment.** — We have said a number of times, in the course of our study, that our mental activities are more intimately related than one might infer from a hasty survey of the chapter headings of a text-book of psychology; that we should think of such terms as Perception, Memory, Imagination, Thought, as the names of the distinguishable or the dominant aspects of the successive portions of the stream of consciousness, not as the names of isolated activities, independent and sharply marked off from one another. Thus each of the functions just named involves, in some measure, the others. Every perception, for instance, involves memory and thought; thought involves memory and imagination; and imagination, perceptual and thought factors. It is only in our effort to psychologize our experience that we distinguish its several phases and give them separate names.

We have next to remark that our distinction of the thought processes, as either Ideations or Judgments, does not mean that they are wholly distinct functions. As a matter of fact, they are closely related; the one always involves the other. Or, stated otherwise, every case of ideation is, in a certain sense, a judgment, and every judgment involves ideation. Thus, in order to think of, to mean, a tree or a star one must think of some of its relations, of its kind, its name or qualities or location, or possibly the bare thought of its existence, that it belongs to the world of things. In a word, all thoughts of things are really implicit judgments. Even the rudimentary forms of recognition, the first dim thoughts that present experiences are similar to or different from earlier ones; the infant's earliest acts of intellectually seizing upon and lifting apart one feature of his world from the total confused mass of sensations and feelings, are rudimentary judgments.

The presence of ideation in judgment is more easily observed. For instance, in order to judge — 'Eagles belong to the zoological order of *raptores*' (birds of prey), or that 'Cicero was an orator', one must first conceive of, mean, the objects related. The judgment consists in the thought of the relation between the conceived objects.

**Judgment and Reasoning.** — According to the classification proposed in this chapter, there are two fundamental forms or kinds of thought processes: thoughts *of*, and thoughts *about*, or conceptions and judgments. Reasoning belongs, in this broad classification, to the group of thoughts about, or judgments; reasoning is a form of judging; or, more accurately, reasoning is a series of intimately related judgments. A part of the work of the succeeding paragraphs will consist in showing wherein judgment and reasoning, as thought processes, are alike and wherein they are different.

**Reasoning.** — For centuries man has claimed the proud distinction of being *the* reasoning animal. But more recently the critic and the iconoclast have come forth to challenge man's exclusive claim to this superiority, and have maintained that the lower animals also reason. It is foreign to our purpose to enter into the merits of the debate that has ensued. It may be observed, however, that the controversy has been prolonged by the failure either to recognize or to state clearly, the fact that there are several kinds, grades, or stages of the reasoning activity. Evidently, the final answer to the question, "Do animals reason?" will depend upon what precisely we shall mean by 'reason'.

We may distinguish broadly two forms of the reasoning activity according to the extent to which the grounds of a given judgment, or conclusion, are factors of the reasoning process. In the first form, explicit reasoning — reasoning in the narrow and more precise meaning of the term — the grounds of the conclusion are clearly and fully set forth; while in the second, implicit reasoning, the grounds are only in part present to consciousness.

Explicit Reasoning. — Explicit reasoning is often described as a series of judgments of whose grounds we are clearly conscious; or as the process of deriving from given propositions their natural conclusions, those that necessarily result from them. Now, while these and similar statements may be accepted as formally correct, they really tell us very little about the intimate nature of the reasoning process. It is necessary, therefore, to search farther for its more or less hidden factors. We have to inquire particularly concerning the grounds whereby we pass from judgment to judgment in reasoning.

As an aid in this inquiry, let us suppose the case of a child who has heard many stories of the ferocity of lions, of how they pounce upon and devour weaker animals, including human beings, but who has never seen a lion or even a picture of one, and so has no idea of what sort of creatures lions are, except that they are dangerous. Let us suppose, further, that the child now visits a menagerie, and that, after a time, pauses in front of a cage containing a lion which we may call 'Duke'. At first, the child's manner is one of admiration, interested curiosity, desire to pat Duke, and so on. Then some one tells him that Duke, the creature in the cage, is a lion. At once the child recalls the fact that lions are dangerous and he immediately concludes that this particular lion is dangerous; his admiration and longing to pat give way to fear and shrinking. His earlier knowledge, stated in the form of a judgment, is: Lions are dangerous; his new knowledge, similarly stated, is — this animal, Duke, is a lion; the conclusion, Duke is dangerous, together with the resulting change in behavior, quickly follow.

A second illustration of reasoning, in the stricter meaning of the term, is afforded by the story of the discovery of the planet, Neptune. The principal events that led to the discovery were: (1) The computation of the motion of the planet Uranus upon the basis of the known influences of the sun, Jupiter and Saturn, i. e., the prediction of the course of Uranus on the basis of these observed influences; (2) the observation that the actual motion of Uranus deviated from the tables based upon the attractive force of these bodies; (3) the proof first by Adams and later by LeVerrier that the irregularities of the Uranian orbit could only be produced by some body exterior thereto; (4) Galle's discovery of Neptune, the disturbing force, in 1846. A formal statement of the steps in the reasoning which led to the discovery of Neptune would run somewhat as follows:

A deviation from the predicted course of a planet is due to the existence of some hitherto unrecognized force. The course of the planet Uranus deviates from its predicted course; therefore, its deviation is due to some hitherto unrecognized force.

Now, in each of the foregoing cases, we have a conclusion or judgment which is derived from earlier ones. And inquiry as to the manner of derivation, into the grounds whereby we pass from one judgment to another should reveal to us the hidden factors of the reasoning process, and should clear away whatever of mystery has gathered about it. Take the two cases separately. In the case of the child and the lion, the necessary first step was the thought that the present object, 'Duke', belongs to, has the characteristics of, a previously known class of objects — 'lions'; and the second necessary step was the revival in the child's consciousness of one of 'lion's' fear-exciting associates, namely, the idea 'dangerous'; third, the idea 'dangerous' awakened its natural associates — shrinking, fear, desire to keep away, and the like. In the case of the discovery of Neptune, the astronomers first identified the motion of Uranus as an instance of deviation from a computed course; second, the idea 'deviation' etc., called up one of its associated ideas, namely, 'some unrecognized force is operating'. The question, what is that force? and the search for it, easily followed. Reasoning proper is thus seen to consist of: (1) a judgment, or a series of judgments based upon observed resemblances (real or imaginary) between present objects and earlier known ones, and (2) the revival through association of certain of the latter's properties or relationships which are, in turn, judged to belong to the object under consideration. A 'good reasoner' is one who is expert in detecting likenesses and differences and who is able to recall ideas that are pertinent to the subject in hand.

**Reasoned Judgments and Reasoning Distinguished.** — It may aid our understanding of reasoning, in the narrow meaning, to show wherein it differs from the process whereby a given judgment, already uttered, is justified, becomes a reasoned judgment. Take two simple cases. The astronomers had computed the course of the planet Uranus on the basis of the known attractive forces of other members of the solar system. Then it was observed that Uranus deviated from its predicted course; next is was surmised that some unrecognized force was affecting the motion of the planet; the search for the disturbing factor, and the discovery of Neptune followed. The conclusion was reached, as we have seen, on the basis of a series of earlier judgments, by a process of reasoning. Now to illustrate the steps whereby a judgment is grounded, becomes 'reasoned', let us suppose that two persons are standing on the shore of a lake which is frozen over; suppose further, that one of the two persons is familiar with frozen bodies of water and that the other has never seen one and knows nothing about them. Suppose that the first person remarks, "How thick the ice is!"; whereupon the second asks, "How do you know it is thick?" The answer consists in stating the grounds of the judgment, thus: thick ice looks thus and so, it easily supports a heavy weight, one can't break it with a big stone, pounding it with a stick produces a given sound, and so on. The next step is — this ice has these properties; therefore, it is thick. The difference between a judgment that is reached by a course of reasoning and a reasoned judgment is thus seen to consist mainly in the difference in the temporal order of the several steps leading to each. In the former case, we advance step by step to a given conclusion; whereas, in the latter, we search out the grounds of a judgment after it has been uttered.

Implicit Reasoning. — It appears from the foregoing sketch that the first step in a particular instance of explicit reasoning is the thought that a particular object belongs to a given class of objects which is known to possess certain characteristics and relationships; further, that the conclusion in such reasoning is reached through the associative revival of some of the earlier known class of object's characteristics and relationships which are then linked to the present object.

Now the same processes are involved, but not all of them are definitely present, in implicit reasoning. In this case, a present fact, or some feature thereof, recalls some earlier known fact, whereupon the qualities or behavior of the latter are forthwith attributed to the former. Sometimes, in this kind of reasoning, the basis of the recall, which, as a rule, is the similarity between some aspect or aspects of the two facts, is unrecognized. Similarity operates, in the manner described above (p. 211 ff), to revive the thought of the earlier fact, but the similarity is not itself separately apprehended.

Everyday experience affords us abundant illustrations of this form of reasoning, i. e., of conclusions based immediately on the resemblance between a present fact and some other known fact. For instance, an oculist describes a given case of eye defect as myopia because it calls to mind similar cases that have received that name. We expect the Oxford graduate B. to speak good English because our friend A., an Oxford man, does so; we expect our new pair of shoes, purchased at X's store, to wear well because an earlier pair purchased there wore well. Of course, the conclusion in a given case may be wholly unwarranted, either because of the faulty form in which our premises are stated, or because of their inherent falsity. Nevertheless, this form of reasoning is often practically effective; and it is at all times satisfactory to a large majority of persons. It is commonly regarded a piece of pedantry or impertinence to inquire too closely into the grounds of a fellow-man's judgments, opinions, beliefs, even when they are evidently based upon shadowy analogies.

Figures of speech, particularly personifications, similes, metaphors, afford other illustrations of implicit reasoning. The poet describes the sea as 'angry' because something in its appearance reminds him of the behavior of an enraged man. The ground of such descriptive terms as 'foxy', 'pachydermatous', 'princely', and the like, when applied to human conduct, is obviously a similarity in the properties of objects that are usually far apart in our thinking. Again, the analogical basis is evident in our characterization of a given person's mind as acute, keen; his speech as cackling or growling, or his character as jelly-like or as standing four-square to every wind that blows.

If we may use the term reasoning in a very broad meaning, we may distinguish a third form — that, namely, in which conclusions, or judgments, are uttered without the distinct apprehension of any ground, but solely on the basis of mental habits of thinking of given things after thinking of other given things. This form of reasoning is meant when it is said that memories or even perceptions involve reasoning, that if we make explicit the grounds of either a perception or a memory we shall have good and true cases of reasoning. For instance, the perception 'oranges', as one looks at a fruit dealer's window display, involves reasoning in the sense that on the basis solely of the sensory experiences of patches of orange color of a given size and form, one names the objects 'oranges'. The implied steps are, oranges are objects of a given size and color; the present objects are like oranges in these respects; therefore, they are oranges.

Further, if this extension of reasoning's meaning is made, then it is true, as is often remarked, that it is involved in even the earliest and simplest cognitive processes. Even the earliest perceptions of infancy may then be regarded as cases of implicit reasoning; that is, if we search for the grounds of these perceptions we shall find among the stored up results of the infant's earlier experiences certain factors which, if brought to light and clearly expressed, would give such perceptions the character of reasoned judgments. To illustrate: reasoning is implicit in the half articulate baby's cry, 'boo', or other sound, which means 'dog' or 'barking-dog-out-there'. The grounds, or warrant for the cry and its meaning, if made explicit, would run as follows:

> Dogs make barking sounds.
> This present sound is one of barking;
> Therefore, it is made by a dog.

Inductive and Deductive Reasoning Distinguished. — The distinction usually drawn between inductive and deductive reasoning is logical rather than psychological. From the former point of view, inductive reasoning is the process of passing from particular facts or instances to general principles or laws, while deductive reasoning consists in applying general principles or laws to particular facts.

A comparison of induction and deduction, from the point of view of psychology, shows the same activities in both, namely, selective attention, comparison, associative revival, and mental habit. Thus in inductive reasoning one first observes that objects of the same class or kind, or that possess in common certain attributes or qualities or modes of behavior, possess also, in common, certain other attributes, qualities, or modes of behavior; second, one concludes on the basis of a number of these observations that the observed concomitance of class of object and attribute, or of attribute and attribute, holds uniformly. For instance, a child observes that certain wooden things — bits of wood, blocks, wooden boats, limbs of trees, boards — float in water, and concludes therefrom that all wooden things will do likewise. Or, again, he observes that dogs that have broad chests, thick necks, and protruding underjaws, are also unsociable, unfriendly, and so undesirable pets; and on the basis of a number of such observations, he forms the habit of thinking that dogs that possess these physical attributes are also unsociable, sullen in manner, undesirable pets. In brief, the essential steps in these and similar cases of inductive reasoning are; (1) attention to some particular property or properties of a given object; (2) the observation that the property belongs also to other similar objects; (3) the habit of thinking of the property in connection with the thought of those objects.

Deductive reasoning shows the same mental activities. One first observes that a particular object resembles in some respect an earlier known class of objects and belongs thereto; next one recalls the attributes that have been associated with the thought of the class and affirms that they belong to the present object. For instance, a child first observes that certain of his toys are wooden; then, recalling that wooden things float in water, judges that his wooden toys will also float in water.

**Thoughts' Vehicles.** — In the section on 'Image and Idea', (p. 143 f.) it was said that it is not necessary to have an image of a thing in order to think of, or mean it; it is sufficient to have its name or label, or any kind of sign whereby we may designate it. We saw, moreover, that we are able to think of, or mean, many things which we cannot perceive or image. For example, we can think of velocity, equality, acceleration, time, space, a plane figure of a hundred sides, a round-square, but we cannot form images of them.

It may be observed next that any item or content of consciousness may serve as the vehicle of our thought of any particular thing or group of things, or of judgments concerning them. Thus in the thought, "The General was present," the idea or thought of the General's presence may be carried by any one of a number of conscious processes; for example, by the sight, sound, or 'feeling' of the words, 'General was present', by an image of some particular General, by a mental picture of a stately figure seen standing, walking, or riding; by the image either of a peculiarly shaped hat, or of the rattle of spurs, or of a commanding voice, or of firmly set jaws; or even a General-like thrill of dignity, or of devotion to duty, or of the sense of responsibility, may serve as the vehicle of such a thought.

No doubt, most meanings are carried by images either of the things meant or by images of the signs and words that name and describe them, or by sensations from the speech organs. But they may be carried also by means of various complexes of unlocalized organic sensations. Take, for illustration of the last mentioned means, Washburn's original suggestion as to the probable origin of the consciousness of contradiction or opposition as expressed by the conjunction 'but'. "The consciousness of 'but'," Washburn writes, in substance, "is a remnant of remotely ancestral motor attitudes, and it resists analysis now because of its vestigial nature. Take, for example, the sense of contradiction between two ideas when we say, 'I should like to do so and so, *but* — here is an objection'. If we trace this back what can it have been originally but the experience of primitive organisms called upon by simultaneous stimuli to make two incompatible reactions at once, and what can that experience have been but a certain suspended, baffled motor attitude?" [1] In other words, the idea or feeling of 'but' must have arisen originally when some 'primitive organism' desired two incompatible 'goods'; when, for instance, some hungry, savage hunter swayed between the desire

[1] *Journal of Phil. Psych. Sci. Methods*, vol. III, p. 63.

to eat his dog and the thought of the dog's help in future hunting excursions. The point is that the 'suspended, baffled motor attitude' which, in the case supposed, constitutes the consciousness of contradiction, of incompatibility between two desired courses of action, is a complex of kinæsthetic, and possibly other organic, sensations; and that these sensations of the primitive organism mean contradiction, opposition.

Now, while it seems probable that sensations of this kind constitute an important, perhaps the chief, factor in the primitive organism's sense of contradiction, it is in place to add that they are also an important factor in the higher organism's — e. g., in a civilised man's — sense of contradiction. Accordingly, Titchener, commenting upon the passage just quoted from Washburn, humorously observes that inasmuch as the sense of contradiction is for him composed partly of the feeling of the suspended motor attitude, an organism need not be more primitive than a professor of psychology in an American university to experience it.

In the present chapter we first studied the general nature of thinking; second, we endeavored to describe the mental activities involved in ideation, or conception, judgment, and reasoning, the simpler, the more fundamental forms of thinking. In the next chapter we shall study comparison, analysis, and generalization, thought processes that involve the simpler forms described in the present chapter.

# CHAPTER XII

## THE THOUGHT-PROCESSES (CONTINUED)

**Comparison: Conditions.**—"Thinking,' Sully writes, 'has in a special manner, to do with the detection of similarity and dissimilarity, or difference." The special form of thought which has to do with the discovery of likenesses and differences is called Comparison, which may be defined as the consideration of two or more objects in order to discover wherein they are alike and wherein they differ. Or, to give Stout's fuller definition:

> "By deliberate comparison', he writes, 'I mean a mental confronting of the two objects, and a transition of attention from the one to the other, so as to discover some respect in which similar things differ in spite of their similarity, or in which different things agree in spite of their diversity, and also a fixing of the precise nature of this agreement or difference." [1]

Two points of this definition require brief notice: first, 'deliberate comparison' is to be distinguished from the mere awareness of difference or likeness which arises 'involuntarily'. The former is purposive, while the latter is purposeless. In the second place, comparison involves not only the search for differences and likenesses among objects, but also a determination of the nature of the differences or likenesses themselves. Thus, in the comparison

[1] *A Manual of Psychology*, 1899, p. 452.

of the tones of musical instruments, we not only inquire whether the tones are alike or different, but we also inquire as to the precise nature of the discovered likeness or difference.

**Conditions.** — The conditions which facilitate the process of discovering likenesses and differences may be grouped as either *objective*, those which belong to the nature of the objects compared, or *subjective*, those which belong to the nature of the individual mind which makes the comparison; we shall give a few examples of each class.

One *objective* condition is that the objects to be compared, whether objects of sense or mental phenomena, shall have one or more features in common. Thus one may compare the jingle of sleighbells and the ringing of a dinner bell, but it probably never occurs to any of us to compare the ringing of bells with the taste of olives. We may also compare one emotion with another, but we do not compare emotions with our visual images. Again, we may compare two Algebra text-books with respect to their precision and accuracy, but we do not compare an Algebra text with one on botany. The existence of a common ground occupied by the objects to be compared then is the first condition of a comparison occurring at all; otherwise there is no motive or reason for it. (2) A second condition is that the objects must be known or believed to be different. We do not compare two pencils which we believe or know to be precisely alike. If we render any judgment at all regarding them it is that they are alike and there the matter ends. In brief, comparison presupposes both a recognized similarity and a recognized difference between the objects compared.

Among the *subjective* conditions of comparison (in addition to the general purpose, already mentioned) should be named, first, the possession of clear and accurate images and ideas of the objects to be compared; and this, in the case of sense-objects, depends in the first place upon the proper functioning of the sense-organs. Obviously the color-blind person cannot discover in a landscape as many colors for comparison as a person whose vision is normal; nor can a person whose hearing is dull in a given direction — say for musical tones — have the materials for comparison in that field. So also the comparison of ideas, e. g., the meanings of two words like 'envy' and 'jealousy' or 'pride' and 'vanity', depends upon the possession of clear and distinct ideas of the meanings themselves. A second subjective condition is the ability to revive and to keep focal in consciousness ideas or images of the objects compared. A little child fails in his comparison of objects, even as simple as two apples, partly because he cannot keep in mind an image of the features of the one while he examines the other.

In discussing a related topic, Stout observes that "the absence of comparison in animals, in all but its most vague and rudimentary form, [is due] to the absence or to the extremely imperfect development of ideational activity in general," i. e., to the inability to image or think of experiences after they have passed.[1]

[1] *Manual of Psychology*, p. 456.

It may be of interest to note in passing that Stout's view in regard to comparison in animals is in striking contrast with that held by the animal psychologists of a generation ago. They would have felt little hesitancy in ascribing the power of comparison to very many of the lower animals, even to the honey-bee that helped King Solomon solve the puzzle of the real and artificial clover blossoms. At the present time, however, the more careful students of animal behavior agree with Stout that comparison in animals, in all but its most vague and rudimentary form, is absent. Forms of animal behavior, which were formerly thought to depend upon the results of comparison, are now seen to be due to either instinctive tendencies or to a simple association between given stimuli and certain acquired modes of responding thereto. Thus the difference in the actions of a cat when it pounces upon a mouse on one occasion and runs from a strange dog on another, is not due to a process of comparison, but to inborn tendencies confirmed by experience. Nor is it correct to say that Morgan's now famous chickens 'learned to discriminate' between nice edible worms and the nasty cinnabar caterpillars.[1] There was nothing in the chickens' behavior, as doubtless Morgan himself would admit, which would warrant one in ascribing the power of comparison to them. 'The discriminating by sight between the two objects', and the association of the appearance or sight of the caterpillar with an unpleasant taste or odor and that of the edible worms with pleasant gustatory results, is sufficient to account for the chickens' quickness to seize the edible worms in the one case and their aversion to cinnabar caterpillars in the other. In general it may be said that no lower animal ever searches for differences and likenesses *per se*: and that animal behavior is controlled either by inherited tendencies or by the tendencies acquired in the course of a series of pleasant or unpleasant experiences, and never by thought.

Discrimination. — We have just stated the general nature and conditions of Comparison. We shall now

[1] *An Introduction to Comparative Psychology*, 1902, Chap. XII.

study a little further that form of comparison, called Discrimination.

Discrimination may be defined as the comparison of two or more objects in order to discover wherein they differ. Thus conceived, discrimination is distinguished from differentiation (which, as we have seen, is the emergence in the course of mental development of an increasing variety of mental experiences) mainly by the fact that differentiation is, in large measure, spontaneous, involuntary, the result of mere inner growth processes, while discrimination, as a thought process, involves a search for differences. For example, in the course of the normal development of the sense of hearing, the child is enabled to distinguish the tones of two musical instruments, the tones are said to become differentiated in his experience; but attention to the tones of the two instruments in order to discover their differences, the discriminative comparison of them, involves a purpose and so implies a higher stage of mental development than the mere consciousness that they are different.

The difference between differentiation and discrimination may be further emphasized by remarking that to experience two different sensations, say of taste or temperature, is one thing; to attend to the difference itself, is an altogether different thing. Thus when first a warm, then a cold object touches a baby's skin, two different sensations arise in the baby's consciousness; but at first there is no idea or thought of the difference as such; much less is there reflection, as there may be in the case of an older person, about the nature of the difference. Discrimination involves the 'focusing of attention' on the difference itself and clearly belongs to a more advanced stage of mental development.

**Individual Differences in Discrimination.** — In our enumeration of the subjective conditions of comparison, we have already referred to the obvious fact that in the field of our sensory experiences comparison depends primarily upon the normal functioning of the sense-organs; if this is lacking the necessary ground for the detection of either differences or likenesses is wanting. It was said also that other necessary conditions of comparison are, (1) the formation of clear, vivid images or ideas of the subjects of comparison; and (2) the ability to retain the images or ideas thereof focal in consciousness while they are being compared. In addition to these general conditions of comparison we may now note certain special conditions of discrimination, which are, at the same time, the grounds of the individual differences referred to in James' observation that some men 'have sharper senses than others, and that some have acuter minds and are able to see two shades of meaning where the majority see but one.' First, may be mentioned the general fact that some persons are naturally keenly alive to distinctions, as such; and that others are dull to them, they seem to lack the sense of difference. "Some persons," as Sully remarks, "are struck more by a likeness, others by a difference."

A second special ground of difference in the discriminating power of individuals is found in the varying sorts and amounts of exercise which this function has received. It is well known that exercise or practice sharpens the wits for distinctions which otherwise are overlooked. A person who is able to draw the sharpest lines within the field of his own special interests and activities, whether practical or theoretical, is blind to distinctions which lie outside his own sphere. The skilled oculist, for example, sees a multitude of differences, which for the layman are wholly non-existent, between the physical conditions and functioning of a normal and an abnormal eye. But let the oculist and a breeder of sheep drive through a sheep-raising country and the latter will be able to point out many things about sheep which entirely escape the attention of the oculist. And so difference in education or exercise accounts in part for the variations among individuals in respect to their discriminating power. The chemist, the lawyer, the sculptor, the merchant, in the course of their education, acquire skill in noting numerous distinctions within their own special fields to which the outsider is deaf and blind.

A third special ground of individual differences in the discriminating power, in the ability to make fine distinctions, depends, Locke suggests, upon the presence or absence of a certain poise, steadiness, and calmness of temper, on the possession or lack of what may be called the judicial temperament, and the mental habits of carefulness which some persons, whose temperaments are hasty and precipitate, are unable to acquire.

A fourth ground of the superiority of one individual over another in marking distinctions is the possession of a richer vocabulary of distinction naming words, which serve both to sharpen one's power of discrimination and to fix distinctions after they are once perceived. Thus, it has been shown experimentally that a person who has a well-developed color vocabulary, i. e., who knows the names of a great variety of tints and shades of color is able to distinguish a larger number of colors than a person, a child, e. g., whose vocabulary is limited. Similarly, in the other sense departments, the ability to discriminate varieties of sense experience is dependent in a marked degree upon the richness or poverty of one's vocabulary. Witness, for example, the great variety of organic sensations, which may become obtrusively real after we once know their names, but which for most persons, fortunately perhaps, are simply non-existent. In a word, wherever our interests, theoretical or practical, require us to make distinctions whether of sensations, feelings, emotions, images, ideas, impulses or purposes, the possession of a wealth of distinction conveying words is a great sharpener of the wits.

**Analysis as a Thought-Process.** — For the little child of three or four, the world of what we call real things consists of a multitude of simple units or wholes without distinction of parts. His toy wagon is something to draw after him; he knows nothing of tongue, bed, axles, coupling-pole, four wheels, nuts and bolts, as parts of the wagon; a chair is something to sit on, not a piece of furniture consisting of seat, back, legs, and rungs; a tree to him is a unit, and the distinctions which an older child makes of root, trunk, branches, bark and leaves, are for him simply non-existent; a doll is something to dress and put to bed; a dog, something that runs and barks; a watch, something that ticks; and so on with respect to all other things in his environment. The notion that they are made up of parts has not entered his mind; and of course, analysis is entirely foreign to his way of thinking of the things about him.

But in the course of experience with wholes or units, which at first make up the child's world, particularly as his stock of words increases, he comes to regard these units as consisting of distinguishable parts or features; he learns that the simple things are really compounds. This process has its beginning very early in childhood, not, to be sure, as a process of conscious analysis, but rather in the child's inborn tendency to select for consideration certain features of the objects about him and to neglect the others. Thus the color of his toys, the 'scratch' of his pet kitten, the bark of the dog, the 'hurt' feature of the hot stove, the various properties of articles of food, are examples of the numerous special features of objects to which he naturally attends. And, as was said just now, the acquisition of language carries with it a multitude of distinctions of parts within the various units of his environment.

Analysis, which Baldwin's *Dictionary* defines as 'the mental function which proceeds by the progressive discrimination of the parts or aspects of any kind of whole', differs from the easy, natural unavoidable analysis of early childhood mainly in the fact that it is always under the guidance of some purpose; as when, for example, the student of biology undertakes the enumeration of the features and parts of a strange plant or animal in order to ascertain wherein it is like and wherein different from those already known; or when a politician makes a careful analysis of what he calls 'the political situation' in order to ascertain the number and nature of the influences which are friendly or unfriendly to his cause. Again, for further illustration of analysis as a thought-process, suppose that a man sets out with the general purpose to build a house. Suppose, further, that he is inexperienced in this sort of thing. He does not know how to proceed. He stands helpless in the face of his problem. He knows in a general way what he wishes to do, but he does not know how to start. Then some one tells him that he should first have pretty definite ideas as to the size, cost, general appearance and arrangement of the house, and that he should then plan the house, one feature at a time — the foundation walls, outside walls, whether of brick, stone, or wood, the character of the roof, inside finish, method of heating, plumbing, decorating, doors, windows, hardware, and so on. His general problem is thus broken up into a number of special problems. He is then able, within the limitations of his general plan, to think of each feature and to reach a decision concerning it. So with respect to the various problems, whether theoretical or practical, which we meet from day to day: we are forced to analyze them in order to proceed at all. In other words, analysis as a thought-process, presupposes a difficulty to be solved; it is purposive, and is thus readily distinguished from the reflex attention which a child may give to the several features of an object of interest, say a doll. As the child looks at the doll she may in turn attend to the color of the doll's eyes, the wavy, golden hair, the tiny feet, the pearly teeth, and so on through the list of features which may catch her attention. But we should not call this analysis; it lacks the essential characteristic of that process, namely, the search for the several parts of which an object is believed to consist.

**The Conditions of Analysis.** — The subjective conditions of analysis are, first, the thought that a given object, event, or situation is compound and not simple; second, a definite purpose to analyze it; and third, previous knowledge of the nature of its separate parts. The first two conditions require no further explanation. They are simply, first, the idea that a given object of contemplation is presumably a compound; and second, the determination to search out its factors. In reference to the third condition—the necessity of having known previously a compound's several parts — James lays down the principle that, "any total impression made on the mind must be unanalyzable, whose elements are never experienced apart." This means that in order to analyze out the several elements, properties, or aspects of a complex situation, object, or event, one must have formerly experienced the elements or properties either isolatedly or in some other relation or combination than the present one. Thus a person who is unacquainted with the tastes of the essences of peppermint, wintergreen, and sassafras would get from a mixture of these substances an unknown single taste, 'a particular integral impression', the ingredients would not be recognized, and an attempted analysis would fail. "But," to quote James' second principle regarding the process of analysis, "if any single quality or constituent of such an object, say the taste of peppermint, 'have previously been known by us isolatedly, or have in any other manner already become an object of separate acquaintance on our part, so that we have an image of it, distinct or vague, in our mind, disconnected with the other two ingredients — [essence of sassafras and essence of wintergreen] then that constituent [essence of peppermint] may be analyzed out from the total impression." We must first be able to image or think of the element or feature which we seek to discover in the compound, and only such elements as we are acquainted with, and can image or think of separately, can be discriminated within a total sense impression. James cites in further illustration of this principle the familiar fact that if one is looking for an object in a room, say for a book in a library . . . . "one detects it the more readily if one carries in one's mind a distinct image of its appearance." Of like purport is the observation that the leader of an orchestra is able to pick out the tones of the various instruments thereof, because he is already familiar with them as separate tones.

It not infrequently happens, after one has discovered all the known elements in a compound, that other features of the total experience are distinctly felt as present although they are not recognized; they are simply known to exist but cannot be identified and named. For example, if one tastes a food or medicine which contains, among other ingredients, Cayenne pepper, and if one has never experienced the peculiar pungency of the latter, then analysis of the total taste experience yields a new factor — whether simple or complex one cannot say—which in accordance with the principle stated above, one fails to identify and of which one is unable to give a complete account.

A further and special condition of analysis is that there shall be a native capacity for, and interest in this mode of thinking. Every normal mind possesses some power of analysis, as it does of discrimination which underlies the analytic process, and perhaps some interest in it. But the capacity varies greatly from individual to individual. Moreover, some persons seem to have a native bent for the analytic method of knowing the world, while others are natively more interested in similarities and likenesses; they look upon analysis as dull and profitless business.

**Generalization.** — Almost a third of a century ago (*Mind,* IX, 1884), James taught the fundamentally important lesson that, as conscious processes, there is no difference between a so-called universal, or general, idea and an individual idea; that as psychic states, they do not differ except in the fact that the former is accompanied by the consciousness that it refers to, or means, a group, or class of objects, whereas the individual idea is felt to mean, or refer to, an individual object. The following quotation contains his teaching in outline:

"Both concept [idea] and image, *qua* subjective [i. e., as segments of the stream of consciousness] are singular and particular. Both are moments of the stream which come and in an instant are no more. The word universality [generality] has no meaning as applied to their psychic body or structure. . . . . It only has a meaning when applied to their use, import, or reference to the kind of object they may reveal. The representation, as such, of the universal object is as particular as that of an object about which we know so little that the interjection "Ha" is all it can evoke from us in the way of speech."[1]

But, apparently, the lesson which James taught was not well learned, and was soon forgotten. Recently, Titchener taught the lesson over, simplified it somewhat, and gave it an emphasis which ought to fix it as our guide in all our future study of the thought processes. He writes:

"It is no more correct to speak, in psychology, of . . . . a general idea, than it would be to speak of a general sensation. What is general is not the idea, the process in consciousness, but the logical meaning of which that process is the vehicle."[2]

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[1] *Principles of Psychology,* Vol. I, p. 479. *Mind,* O. S., IX, 1884, 18 f. The same teaching is implicit in BRADLEY'S *Principles of Logic,* 1883.

[2] *Experimental Psychology of the Thought Processes,* 1909, p. 15.

Stated with a slightly different emphasis, the two points of these quotations are, first, that in the field of actual mental experience there is no such thing as a 'general' idea; as mental processes, every idea (image) is particular; and second, that certain of our conscious processes, images, e. g., mean groups or classes of objects which possess characteristic attributes or properties. We can think of, mean, trees, knives, clocks, as groups, and we can render judgments regarding them which are true of all their members. These meanings, or thoughts of, groups or classes of objects having common features are called 'generalizations', or 'general ideas', or 'general notions', or 'concepts'; but, to repeat, these terms one and all express *meanings;* they do not name special kinds of mental states.

Now, there are two questions of psychological interest regarding the process of Generalization as thus conceived: first, how do we come into possession of our general meanings; second, what sorts of conscious processes serve as their vehicles. In answer to the former question we may observe first that thoughts of classes of objects, such as those named in the preceding paragraph, first appear naturally in the course of our learning the language of our elders. We hear them apply the names—'tree', 'knife', 'clock', to certain objects, and we imitatively use the same words to designate the same things. Then it is an easy step from using a given sign to mean a given individual object to using the same sign to mean any or all objects which resemble the first. That these are the early steps in the acquirement of general meanings, or so-called 'general ideas', is clearly shown by observation of the language of little children, particularly the mistakes which they make at first. For example, a child uses a given name to refer to the house cat; then later he applies the same name to all cats; later still he calls tigers, leopards, lions by the same name which he first used to name his pet. Or again, he hears a watch called a 'tick-tock', which name he soon gives to a clock, because it, too, has the ticking sound; then later, he may call a calendar or a thermometer tick-tocks, possibly because their graduated surfaces resemble roughly the face of a time-piece. And his later education, which clears up these errors, consists in getting him to see that the similarities which he first noticed are unimportant, that they do not relate to the essential properties of the objects classified, and therefore cannot be the true grounds of classification. The procedure in this case is precisely like that followed in teaching the student that the mere fact that a whale lives in water is no warrant for calling it a fish, or when he is taught that a sea anemone is an animal despite the fact that it lacks the power of locomotion, which he first believed to be characteristic of all animals. Indeed, our entire education is, in an important respect, a process of correcting our first groupings and classifications, which in many instances, are based upon similarities that are superficial and unessential.

By a similar process of 'automatic assimilation', as Sully calls it, the child gets his first groupings of objects or actions as pretty or ugly, as true or false, as fair or unfair, good or bad, and so on. He hears his associates name certain things pretty or ugly, fair or unfair, good or bad, and he spontaneously applies the same names to objects and actions which resemble in some respects the things which he has heard others describe by these words. Of course, the child makes the same sort of mistakes in using the more abstract terms that he made in using the more concrete; and the task of education in the latter case, is the same as in the former.

Thus far we have spoken only of generalization which requires little effort, which consists in the simple process of applying the same name to objects which resemble one another. A distinctly higher stage of this form of thinking is reached when a child begins consciously to compare objects, events. situations, in order to determine their likenesses and differences, and when he begins to make ascertained differences and likenesses the basis of his classifications. Moreover, he may at this later stage undertake the revision of his earlier general meanings. he inquires into their grounds. He asks, why the giant oak and the patch of moss on its trunk are both called plants, why are some words called adjectives and others adverbs, why is one piece of conduct called patriotic and another treasonable. And all through life he is interested more or less in classifying, defining more sharply, and in fixing his general meanings.

The answer to the second question mentioned above, namely, what is the character of the mental processes which serve as the vehicles of generalizations, has been indicated already in the topic — 'Thoughts' Vehicles', (p. 266 ff.)

The Beginnings of Thought. — We are already familiar with the general fact that even in the earliest stages of an individual's mental development, the various mental activities are so intricately interwoven, and the development of each one so depends upon and involves the development of others, that the date of the first appearance of any particular one cannot be definitely ascertained. So we may say of the thought processes in particular that the attempt to isolate them from the totality of an individual's early experience and to lay one's finger on their earliest forms will, for the general reason just mentioned, always end in failure.

But in order to give any account of mental development at all, we have to take one aspect or feature of the developmental process at a time; we have to break up into parts what is in reality an organic whole, and consider the evolution of the various individual mental functions as if they existed in isolation. So our inquiry concerning the beginnings of the thought processes is merely an effort, first, to ascertain the character of their rudimentary forms; second, to determine the conditions under which they become distinguishable features of consciousness.

There has been a good deal of discussion of the question — does consciousness always involve a thought element? Otherwise stated, is there such a thing as a 'thoughtless' mental experience? More concretely, may we suppose that some of the lower forms of animal life, say a caterpillar or an oyster, experience sensations of pressure or warmth as bare, disconnected bits of consciousness, as pure sensations? or does the mere existence of such processes involve thought? To these questions the most natural answer is that the consciousness of many of the lower animals, and that also of the higher animals, at the outset, is thoughtless. For example, it is highly probable that at first a baby's mental life consists of a mass of vague, undifferentiated, unrecognized, and unacknowledged sensations and feelings. It is likely that bare sensations of the first baths, the first tastes, the first movements of arms and legs occur without involving as much thought as is expressed in an inarticulate Ah! or Ouch! At this stage of development the baby's mental life, so we may suppose, consists of a series of sensation, or of sensation and feeling, complexes which appear one by one, then fade away. Each one, so far as the experiencing subject is concerned, is an entirely new experience; it awakens no memories of former states; when it dies, it leaves absolutely no conscious trace of its having been.

Now, let us suppose, that in due time, a trace of these first sensations and feelings lingers in our imaginary baby's mind, and that the occurrence of later pulses of sensation and feeling is accompanied by a dim feeling either of familiarity or of strangeness; then the consciousness of the moment would include either the thought 'this is like', or 'this is different from, an earlier thing.' Now thought, as a distinctive feature of consciousness, begins in these first dim, faint awarenesses of likeness or difference; and all of the similarities and distinctions which we are able to discover in our later life trace back to these two different ways of responding to the various objects of our babyhood environment.

The student will understand, of course, that any account of the earliest forms of mental experience is, in large part, an imaginary affair. No one is able to recall his first sensations, feelings, thoughts; and our attempt to picture the mental life of a baby professes to be only a statement of what probably occurs in these early hours and days which are, in fact, sealed books to us all.

The student should also understand that statements in regard to the mental life of the lower animals are speculative in nature. It is, however, generally agreed that it is highly improbable that the lower animals image or think about their experiences; and it is doubtful whether their sensory and perceptional processes resemble those of human beings as much as most persons nowadays suppose.

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## CHAPTER XIII

### THE FEELINGS

**Meaning of the Term Feeling.** — The term 'feeling' is used in the language of everyday life with a great variety of meanings. Thus, to quote a paragraph, with slight changes, from Titchener's *Primer of Psychology*:[1]

"(1) Feeling is used for the perception of touch. We say a thing 'feels rough' or 'smooth', 'hard' or 'soft'.

(2) It is used for certain organic sensations, whether they are strongly tinged by affection [i. e., whether they are agreeable or disagreeable] or not. Thus we 'feel hungry' and 'feel thirsty', although the hunger and thirst may be neither strongly pleasant nor strongly unpleasant.

(3) It is used for some very complicated affective processes, for emotions and moods. Thus we 'feel angry' or 'feel blue'. Anger is an emotion; 'the blues' is a mood."

(4) Feeling is also used as the equivalent of 'think' or 'judge', as when one says, "I feel that so and so is true or false, wise or unwise, good or bad, etc." (5) Again, in ordinary speech, 'feeling' means an attitude of assent, agreement, hearty concurrence, as when it is said that a banquet speaker made a 'feeling response' to a given toast. So also in works on psychology, 'feeling' is used in a great variety of ways. Thus some psychologists, e. g., Titchener, mean by 'feeling' either 'a simple connection of affection (pleasantness or unpleasantness) and sen-

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[1] *Primer of Psychology*, 1907, p. 61.

sation', in which affection is the predominant factor; or 'the affective side of our mental life.' Other psychologists mean by 'feeling' any mental process; feeling and consciousness are used synonymously, e. g., by James when he says, in his chapter on The Emotions, "the feeling [consciousness] of certain bodily changes as they occur *is* the emotion." Truly, as Titchener remarks, " 'Feel' and 'feeling' seem to be psychological maids of all work; they can do, in the sentence, practically anything that a verb and a substantive can be called upon to do."

In our own present use of the term 'feeling' we shall mean the pleasantness or unpleasantness, the agreeableness or disagreeableness, which run through, and give tone, color, and immediate value to our mental experiences. For example, the sight of the colors of the rainbow, the sound of a musical melody, the taste of certain fruits, the odor of given flowers, are usually accompanied by feelings of pleasantness; while muddy colors, grating, rasping noises, the odor of decaying animal matter, the bitter taste of quinine, are, as a rule, accompanied by feelings of unpleasantness.

The student's attention is called to two further points in respect to the meanings of the terms used in discussing feeling: (1) the word 'pain' has two meanings in books on psychology. Usually it means a sensation; but occasionally it is used synonymously with unpleasantness, unpleasureableness, disagreeableness, and as a convenient substitute for these unwieldy terms. (2) The expression 'feeling-tone of sensation' refers, in this text, to feeling as an elementary psychical process which accompanies sensations.

The foregoing definition of feeling implies that our mental life derives its immediate value and interest from its affective character. Whether or not a given experience shall be deemed interesting or valuable depends upon whether or not it "touches the feelings." For example, the sight of a beautiful bank of flowers, a discord in music, the fragrance of apple-blossoms, the foul odors of bad drainage, sweet and bitter tastes, ideas of good or ill fortune, all owe whatever of value they may have for our present consciousness to the fact that they are accompanied by feelings of pleasantness or unpleasantness. The language of everyday life bears witness to the fact that our immediate sense of the value of an experience originates in the feelings. Thus, to speak of a certain person as apathetic or blasé, in the presence of natural scenery which ordinarily fills others with the keenest delight; or of a given school boy as sated with school work; or of a hardened criminal's indifference as to his fate; of the growing recklessness of an administrator of a public trust, is another way of saying that the scenery, the school studies, the gallows, the ideas of public service, no longer elicit their usual feeling responses. If a sensation or idea is accompanied by a feeling, it has a present value for the consciousness; if it is not, it has none.

**The Number of Kinds of Feeling.** — The question of the number of kinds of feeling has been much in debate in recent years. In the main, the discussion has centered about 'the tridimensional theory of feeling,' proposed by the German psychologist, Wundt; and it will be sufficient for our present purposes to indicate, (1) the chief features of that theory, (2) the principal arguments that have been urged against it.

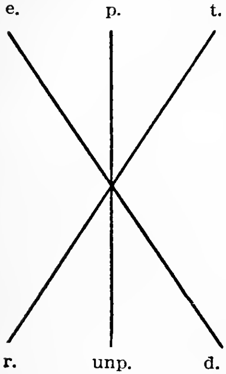


FIG. 34. Diagram representing Wundt's three dimensions of feeling.

Wundt teaches that there are in all six distinct classes of feeling, namely, pleasantness and unpleasantness, excitement and depression, tension and relaxation; also that these six elementary forms or groups of feeling may be arranged in pairs of opposites, forming three series, and that each series comprises a vast number of distinct feeling experiences. The accompanying diagram (Fig. 34) represents the relation in which Wundt's six groups of feelings stand to their opposites.

A further characteristic of Wundt's theory is that any actual feeling may belong to all three series, or it may belong to only two, or even to only one. For example, a noise, say that of a fire-engine dashing along the street, may be accompanied, in a given instance, by a certain pleasantness or unpleasantness, by a more or less marked feeling of strain or relaxation, and also by a feeling of either excitement or depression. Another sound, say the tones of a distant bell, may awaken, in a given case, feelings either of pleasantness or unpleasantness and of either tension or relaxation, but nothing that could be described as excitement or depression. In still a third instance, we may suppose that the feeling experienced, that aroused by a musical chord, e. g., belongs only to the pleasantness — unpleasantness series; the experience is pleasant or unpleasant, but it contains no traces of excitement or depression, of strain or relaxation.

Now it should be said at once that nearly all psychologists agree in calling pleasantness and unpleasantness feelings (or affections or affective experiences), and that the discussion concerning the number of kinds of feeling centers chiefly about the question—should the consciousnesses called 'strain', 'relaxation', 'excitement', 'depression', be classed as feelings or as sensations? As we have seen already in our outline of his tridimensional theory, Wundt classes them among the feelings, alongside pleasantness and unpleasantness. Titchener, on the other hand, after a careful examination of Wundt's teaching, reaches the conclusion that the groups of experiences which Wundt and others call feelings of excitement and depression, and feelings of strain and relaxation are really *sensations* from the muscles, tendons, joints, skin, organs of circulation and respiration, etc., which are at times closely blended with the feelings of pleasantness and unpleasantness.[1] For example, if one is expecting a present on a certain mail delivery, one awaits the postman's arrival with pleasure, but alongside the pleasure there may exist, as a result of changes in

[1] *Elementary Psych. of Feeling and Attention.* Lecture IV, p. 125 ff.

breathing, heartbeat, the excitation or inhibition of bodily movements and the like, sensations of strain and possibly of excitement. When the present arrives, the strain may give way to relaxation; the excitement, to quiet and calm. In all such cases, the experiences of strain, excitement, and their opposites, consist of sensations, chiefly organic in nature. As Titchener remarks in the Lecture cited above, "organic sensations are responsible for the [Wundt's] dimensions of excitement-depression, and tension-relaxation."

In the opinion of the present writer, the advantage in this discussion is on the side of Titchener and those who hold with him that there are only two classes or kinds of feeling, namely, pleasantness and unpleasantness, and that all other differences, excepting those of intensity and duration, in our feeling experiences, are due to their sensational, imaginal, and ideational accompaniments. However, as was said above, the question is still in debate, and the final solution will depend upon what precisely we are to mean by a 'feeling', upon what, as Titchener says, are the criteria of feeling.

The question of the number of kinds of feeling should be clearly distinguished from the question of the number of kinds of pleasantness and unpleasantness. Certain authors teach that there are not only more than two kinds of feelings, but that there are also many kinds each of pleasantness and unpleasantness. Ladd, for example, contends that the pleasures of sense are, as feelings, different from the more elevated intellectual, æsthetical and ethical pleasures — even though the two classes of pleasures be graded to the same degree of intensity. Now it is of course true that the total experiences, such as eating freely of a favorite fruit and of turning fondly through the pages of one's favorite author, are very different; but the difference is not due to the difference in the *kind of feeling* present in the two experiences, but rather to the difference in the accompanying sensations, images, and ideas.

**The Mental Conditions of the Feelings.** — Broadly stated, the view here advanced concerning the mental conditions of the feelings is that they are dependent upon certain of the attributes (quality, intensity, and duration) of the sensations and the relations which arise among these attributes. In other words, the feelings of pleasantness and unpleasantness are 'functions', in the mathematical sense of that term, of sensation attributes and their relations. Furthermore, some feelings are dependent chiefly upon certain attributes of the special sensations (sight, sound, taste, smell, etc.); some mainly upon the attributes of certain organic sensations (tension, strain, hunger, thirst, etc.); and some, so far as rough observation can determine, upon sensations belonging to both these groups. Let us consider first:—

**Feeling and the Quality of the Special Sensations.**— Many of the feelings of our ordinary daily experience depend primarily upon the quality of the special sensations. Thus the pleasantness of the taste of a favorite fruit, of the odor of a field of blossoming clover, of the sight of a bush full of roses, of musical chords, of the touch of velvet, depends in each case primarily upon the quality of the accompanying sensation; likewise, the unpleasantness of the bitter of quinine, of the odor of a carrion, of muddy colors, of discords, depends chiefly upon the quality of the sensations excited.

The reasons for believing that, in many instances, the feelings depend primarily upon the *quality* of the accompanying sensations are, first, the fact that they usually appear in consciousness simultaneously with sensations and seem to be inseparably connected with them; and, second, many sensations possess a characteristic feeling-tone, independently of their degree of intensity, their duration, and their relations to other sensations. Thus, to most persons, the odor of a favorite perfume is pleasant, a bitter taste is unpleasant, irrespective of their other properties or relations. The feeling in each case is dependent mainly upon the *quality* of the sensation.

Feeling and the Organic Sensations. — A second great group of feelings are dependent mainly upon the organic sensations, particularly the kinæsthetic sensations and sensations originating in changes in the organs of respiration, circulation, and digestion.

FEELING AND CONATION. — Conspicuous in this group are those feelings which arise in connection with our 'conative tendencies', as they are called, namely, our instincts, our inborn impulses, our native or acquired cravings, longings, yearnings, our strivings, efforts, desires, wishes, volitions, and the like. But before stating more explicitly how the conative tendencies derive their characteristic feeling-tone from the organic sensations, let us consider for a little while the more obvious relations of the feelings to these tendencies.

In respect to this relationship, Stout writes: "Whatever conditions further and favor conation in the attainment of its end, yield pleasure. Whatever conditions obstruct conation in the attainment of its end, are sources of displeasure."[1] The same truth is expressed by Ladd, as follows: "The tone of our feeling (whether pleasurable or painful) depends largely . . . . upon the degree of smoothly running flow, or interruptions and shocks, to the current of consciousness;"[2] and by Judd in the following statement: "So long as the various tendencies toward action which are present at a given moment contribute favorably to mutual progress, the feeling-tone of experience will be agreeable; as soon as active tendencies conflict, they will be accompanied by a disagreeable feeling."[3]

Let us next note a few familiar instances of the dependence of the feelings upon whatever conditions obstruct and hinder or favor and further the conative processes. First, we may glance at the field of instinctive behavior.

(1) Feeling and instinctive tendencies. — Our native impulses are fertile sources of pleasantness and unpleasantness. Pleasure accompanies the free, unhampered functioning of our instinctive tendencies; whereas, if they are crossed, delayed, or denied free action we feel displeasure. One finds the most striking illustrations of this truth in the behavior of little children. The child's impulse to play, to be active all his waking hours, his curiosity to see and hear and touch and handle all new things, when free

[1] *A Manual of Psychology*, 1899, 234.
[2] *Psychology: Descriptive and Explanatory*, p. 199 f.
[3] *Psychology*, p. 196 f.

and unrestrained, are clearly the source of great joy. On the other hand, hindrances to his activity, restraint or interference with his native impulses, produce unmistakable signs of displeasure; and throughout life our inborn tendencies, unless they have been uprooted or transformed, remain important conditions of our joys and sorrows. The egoistic instincts, the expressive instincts, the instincts of pugnacity and mastery, sensational and intellectual curiosity, imitativeness and emulation, acquisitiveness, the social and parental instincts, each in their turn and in their free play, or in their conflicts and inhibitions, give the individual life much of whatever tone and color and value it may possess.

(2) Feeling and sense-craving. — The relation of feeling to sense-craving is similar to its relation to the instincts. The satisfaction of a craving, whether natural, as for food in hunger, or artificial, as for certain kinds of stimulants, is accompanied by pleasure, while its frustration causes displeasure. The food or the stimulant in itself and apart from the craving may not be pleasant; it owes this quality to the fact that it satisfies a desire, as is evident when one remembers that in moderate hunger the taste of a given food may give keen pleasure, while in satiety the same food may be nauseating.

(3) Feeling and active attention.—Feeling stands in a close relation to active, or voluntary, attention. The 'will' to attend to a given object or idea, if successful, gives pleasure; if unsuccessful, if it is obstructed or interfered with in any way, we feel displeasure. Illustrations from our everyday life will

readily occur to the student. Thus when one is trying to solve a knotty problem in mathematics, or is racking his brain in an effort to recall a forgotten law or principle, or is striving to get the meaning of a difficult paragraph, but cannot attend effectively to his task because of talking and laughing in an adjoining room, one experiences the displeasure of disturbed or distracted attention.

(4) Success and defeat as conditions of feeling.—It is one of the most familiar of our experiences that success in our undertakings gives pleasure and that defeat brings pain. Illustration of this fact would seem unnecessary, since the whole round of life, from the eager games and contests of childhood and youth to the most serious concerns of mature life, is run through and through with the joys of success and the anguish of defeat. Likewise, whatever conditions favor the attainment of a desired object or aim are pleasant; those which thwart its attainment, unpleasant. Hence, e. g., the joy in the full purse and its power to provide the summer outing, or to purchase the coveted set of books, or the collection of rare pictures; hence the pangs of poverty and the inability to obtain a fair portion of this world's goods.

Now the point which we wish to emphasize in respect to all these experiences is that the feelings which are ordinarily attributed to the furtherance or the hindrance of our conative tendencies really belong to, and are immediately dependent upon, the accompanying organic sensations, particularly the kinæsthetic sensations of tension, strain, excitement and certain sensations, hard to name or describe, which accompany the free, easy, normal functioning of the various bodily organs. Stated otherwise, the feelings of pleasantness or unpleasantness that accompany the furtherance or hindrance of the conative tendencies depend upon the organic sensations of tension, strain, effort, excitement, and their opposites which, so far, psychology has not adequately described.

What is known as the 'pains of distraction' affords a good illustration of the feelings that, in a sense, are due to the obstruction of conative tendencies but which can be adequately explained only by pointing to their dependence upon a complex of organic sensations. Distraction presupposes a state of pre-occupation, and this in turn presupposes a muscular set or attitude appropriate to the dominant mental trend. In looking or listening intently, in trying to recall something once known but now forgotten, in weighing the pros and cons in respect to a proposed course of action; briefly, in any case of attentive consideration, one assumes either from habit or instinctively a particular bodily attitude which sustains, so to say, the purposes or interests of the moment. Now in accordance with the principle already stated, anything that breaks across or disturbs this bodily set, this temporary adjustment of the organism to a particular task, excites disagreeable feelings. On the other hand, whatever favors and furthers it produces pleasureable feelings.

Moods: Pains. Moreover, we find in the organic sensations as a group and as individual processes the conditions of the feeling-tone of certain other familiar experiences. What we ordinarily call our 'mood' or 'temper' whether of cheerfulness and geniality or of gloominess, malaise, sullenness, owes its distinctive character in large part to the state of our bodily organs and the group of sensations originating therein. Besides these pervasive feelings, due to the fused total mass of organic sensations of a given period, there are others more clearly marked and more insistent that are dependent definitely and directly upon particular organic sensations which stand out from the existing total sensation complex. For example, the disagreeableness of nausea, hunger, thirst, excessive heart throb, disturbed respiration, and colic pains are striking instances of the intimacy of the relationship of the feelings to particular organic sensations. Feelings of pleasantness are also definitely correlated with certain organic sensations originating in the free, normal functioning of the various bodily organs.

**Some Feelings dependent on both the Special and the Organic Sensations.** — We have seen in the preceding paragraphs that some of our feeling experiences are dependent chiefly upon the quality of the special sensations and that still larger portions are conditioned mainly by the organic sensations. We may turn next to those feelings that are dependent upon both these sensation groups.

It will help us to understand the two-fold character of the conditions of this group of feelings to recall, first, that all effective sensory impulses, besides exciting definite portions of the cerebral cortex, excite in addition thereto larger or smaller sections of the brain and spinal cord, and through these the outlying bodily organs. "There is in such cases', Stout writes, 'a diffused excitement of the nervous system . . . . superadded to that special excitement which is immediately correlated with the existence of the sensation." Now this 'diffused excitement' of the nervous system necessarily involves, we have said, a greater or less excitement of the bodily organs; this in turn involves a wave of sensory impulses flowing backward to the brain and the arousal of a group of organic sensations with their own special feeling tones. To quote McDougall, "The feeling excited by an impression made on one of the higher senses is often due in part to reflex changes produced in the viscera, which in turn excite organic sensations with well marked feeling-tone." [1] Briefly, a sensory impulse that is strong enough to excite a special sensation, having a clearly marked feeling-tone, will also excite, in the manner described above, a group of organic sensations with their characteristic feeling accompaniments; and the resulting feeling, whether of pleasantness or unpleasantness, is conditioned by these two classes of sensations. To illustrate: it is a matter of everyday observation that the feelings accompanying given color sensations, musical tones, noises, tastes, odors, touch-blends are compounds of feelings immediately related to the sensations themselves and of feelings due to the attendant bodily commotion. The disagreeableness of a grating noise, or of a foul odor, or of muddy colors, includes besides the feeling characteristic of the sensation itself also a mass of feeling from the organic sensations that are ex-

[1] *Physiological Psychology*, 1899, p. 80.

cited therewith. So also the pleasantness of bright colors, musical tones, and of agreeable tastes or odors, is oftentimes strengthened and corroborated by a wave of pleasant feeling from concomitant bodily sensations.

**Feeling in Relation to the Intensity and Duration of Sensations.** — It remains to state briefly the relation of feeling to the intensity and duration of sensations.

**Intensity.** — The general statement of the relation of the intensity of sensations to the feelings is as follows: (1) Many sensations at a low degree of intensity have no accompaniment of feeling; they are said to be neutral; (2) pleasantness or unpleasantness attaches to all sensations when their intensity is increased; (3) some sensations are either pleasant or unpleasant at all degrees of intensity; (4) most sensations become unpleasant at a high degree of intensity; and (5) the initial feeling-tone of some sensations increases with the increase in intensity of the sensation up to a determinable point when the feeling, if initially pleasant, becomes unpleasant; if originally unpleasant, it either remains stationary, or gives way to indifference.

**Duration.** — The experience of everyday life teaches that the feeling-tone of sensations depends in part upon their temporal properties, i. e., whether they are brief or prolonged, continuous or periodic, rhythmical or fitful. Generally speaking, the prolongation of a sensation results in dulling the accompanying feeling. This is true whether the sensation is weak or intense, pleasant or unpleasant. Thus the pleasure one derives from a given combination of colors, or a popular melody, or a new product of the culinary art, fades, or even, in some cases, gives way to displeasure, if the conditions require gazing at the colors continually, or if the melody is constantly dinned in our ears, or when the new discovery in the culinary department makes its appeal too persistently. The same principle holds of disagreeable sensations. The odors of the dissecting room, the ugliness of a wall paper, the nerve-racking noises of a great city, cease, after a time, to affect us disagreeably; or even, in some cases, owing to a process of accommodation, sensations which are originally disagreeable not infrequently become pleasant. The best illustrations of this transformation are seen in the acquired taste for olives, for tobacco, and for bitter drinks. Thus we find two sets of results due to the prolonged or frequently repeated stimulation of the sense-organs; (1) the lowering of the intensity of the original feeling which the stimulus excites, due possibly to the lowered functional activity of the sense-organs involved; (2) a change in the quality of the feeling-tone of a sensation due to a process of accommodation in the sense-organs.

**The Neural Correlates of the Feelings.** — We have assumed throughout our study of the mental life that every mental process is correlated with a process in the nervous system, that 'every psychosis has its neurosis', to quote Huxley's phrase once more. The feelings of pleasantness and unpleasantness are not excepted in this general statement, and we have now to ask, what changes in the nervous system accompany these states. It must be said at once that when we ask for precise information concerning the neural correlates of pleasantness and unpleasantness, when we ask how the neural conditions of the one differ from those of the other, we get no completely satisfactory answer. Our positive knowledge is extremely meagre, and theories differ widely. Our present study will be limited to a review of the latter.

It was maintained in the preceding paragraphs, first, that the feelings are dependent upon the *quality* of the special and the organic sensations; second, that the feelings are conditioned partly by the *intensity* of the concomitant sensations; and third, that the feelings depend in part upon the temporal properties of sensations. Now the question in all these cases is: what changes in the nervous system are correlated with a particular sensation quality or intensity or duration which gives it its characteristic feeling accompaniment?

It seems very natural to say in answer to this question, first, that since the quality, intensity, and duration of sensations are due in the main to the character, intensity, and duration of the sensory stimuli, the latter are likewise determinants of the character of the concomitant feelings; second, that any sensory stimulus that affects us pleasantly is physically beneficial, and one that affects us unpleasantly is physically injurious. And, speaking very generally, we do find that agreeable stimuli promote our physical well-being, and that disagreeable ones are harmful. But there are many exceptions to this general statement: as Angell observes, 'neither agreeableness nor disagreeableness is unambiguously prophetic', i. e., many pleasant stimuli are followed by harmful results, and many that are unpleasant, by results that are beneficial. In illustration of this familiar fact, Stout writes:

"Sugar of lead has a sweet taste, which is pleasing at the moment; this pleasing taste may in itself be favorable to vital activity, although the substance which occasions it, when introduced into the blood, acts as a deadly poison. Similarly, a bitter drug which is disagreeable to the taste, may have a beneficial medicinal effect. The beneficial effect is not due to the disagreeable bitterness, but to subsequent effects entirely disconnected with the original experience."[1]

And yet, Stout seems to say, in the passage just quoted, that pleasantness and unpleasantness, as a rule, are reliable signs of the beneficial or harmful character of physical stimuli. And this is the teaching of most students of the relation of pleasure and pain to physical well-being. But even so, this is only one step toward a statement of the neural conditions of pleasantness and unpleasantness.

Feelings Dependent upon Anabolic and Katabolic Processes.—Among the several theories of these conditions that have been proposed the most widely favored one attributes pleasantness to processes of repair and upbuilding in the sense-organs and nervous system, and unpleasantness to breaking down processes. According to this view, stimuli of a given kind and intensity and duration produce in the

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[1] *Manual of Psychology*, 1899, p. 229 f.

nerve tissues physical and chemical changes which, in their general character, are destructive, and which occasion a feeling of unpleasantness, while stimuli of another kind and intensity give rise to constructive processes and the resulting feeling of pleasantness.

In this theory we have a plausible suggestion as to the neural conditions of many of the feelings; but the student should remember that it is at best only a guess, and moreover, that the details of the theory are far from being complete. Thus we do not know precisely *what* these changes are, we do not know *where* they occur, nor do we know how their effects are transmitted to the cortical centers. Again, we do not know how they differ in different persons, why the same object arouses different feelings in different individuals; or why, precisely, a sensory experience that, at one time, thrills us with the keenest pleasure, at another, fills us with disgust. Popularly we attribute such differences to individual idiosyncrasies, to differences in physical constitution, to passing changes in physical tone, or to habit and early associations; but we cannot tell in detail wherein the physical grounds of the differences lie.

**Feelings Dependent upon Favoring-Obstructing Nerve Processes.** — The theory just mentioned, that pleasant feelings are dependent upon beneficial, or anabolic, processes in the nerve structures and that unpleasant feelings are dependent upon destructive, katabolic, processes — the harmful-beneficial theory of feeling, it may be called — seems to account roughly for a large portion of our feeling experiences, but not for all. It fails conspicuously as an explanation of those feelings that accompany our conative tendencies. In respect to this relationship we have said that any condition or situation which favors the conative processes is agreeable and that whatever obstructs or hinders them is disagreeable. It was maintained, further, that feelings of unpleasantness are intimately related to the bodily sensations of strain, stress, effort, and that pleasurable feelings depend upon sensations of freedom, ease, lightness. But there is little or no reason for thinking that tension and effort are symptomatic of predominantly destructive processes in the nerve tissues or that freedom and ease indicate the presence of constructive, upbuilding processes. Pleasantness, in these cases, is not uniformly correlated with constructive processes in the nerve tissues, nor unpleasantness with destructive ones. We must look elsewhere for the neural conditions of the hindrance-furtherance feelings. To the present writer it seems plausible to suppose that in these experiences incoming nervous impulses which favor and corroborate those already in existence cause pleasure, and that when the existent nervous tendencies are hindered or obstructed by incoming currents we feel displeasure. For example, it does not seem fanciful to suppose that the disagreeableness of distracting noises, say when one is trying to compare two neighboring notes on the musical scale, is correlated with collisions or cross-currents of the nervous impulses from the several sets of stimuli. Or we may liken the neural disturbance correlated with unpleasantnesses of this kind to the effect produced when one stream flows into and crosses another; or again to the commotion caused when two bodies, moving in different directions, collide. Following the analogy of moving bodies, we may liken the process in the nervous system which underlies pleasantness to that found when the effect of one moving body is to accelerate the motion of another; and that which conditions unpleasantness, to the obstruction of the course of a moving body. In brief, anything that facilitates the action of existing nerve processes gives pleasure, and blocking or crossing them causes displeasure.

To summarize: in the preceding paragraphs we have maintained, first, that there are two and only two qualities of feeling — pleasantness and unpleasantness; second, that the feelings are conditioned chiefly by the quality of the sensations, special and organic; third, that the neural basis of feeling consists of either metabolic or favoring-obstructing processes in the nerve tissues.

**Feeling and Habit.**[1] — It is often remarked that custom dulls feeling. Thus, persons dwelling in the midst of beautiful natural scenery grow indifferent to its charms. The pleasureable interest one has in a new city or country, in listening to new music, or in looking at a new collection of pictures; the joy one finds in travel in a foreign land, the child's de-

[1] The relation of what is somewhat loosely called 'habit' or 'custom' to our feeling-life is varied and complex, and any description of this relationship which one may give, while it may apply in a given situation, is subject to modification when the situation changes.

light in his new toys, in strange things, in ornaments, all tend through custom to fade away.

In like manner, we become insensible, through dint of repetition, to characteristics of our environment which at first are harsh and ugly. Disagreeable aspects of our trade, business, or profession, ugly features in our daily surroundings, in time lose their power to affect us unpleasantly. The classical illustration of the blunting of the feelings in respect to things which are originally unpleasant and abhorrent is found in the callousness of the grave diggers in Shakespeare's *Hamlet*. The reader will recall their rude jests and songs as they go about their work, which, to most persons, seems quite the opposite of jest and mirth provoking. As Hamlet and Horatio observe the grave makers, the former remarks:

"Hath this fellow no feeling of his business, that he sings at gravemaking?" to which Horatio replies,

"Custom hath made it in him a property of easiness."

Very similar to the change which habit works in our feelings in respect to large, gross situations which at first affect us unpleasantly, is the change which occurs in the process of mastering the first steps of new studies, arts, crafts—for instance, of a foreign language, of piano technique, of telegraphy—in fact, of any new subject or art which, at the outset, requires intense application and effort. At first, the necessary exercise is painful, but by a process of accommodation it loses this quality or even, in some cases, becomes pleasurable.

While it is true that our feelings tend toward the indifference point in regard to those things which form constant features of our environment, there grows up, quite unconsciously, a fondness for what is habitual and familiar. Persons often become attached to lives, kinds of work, or environments which at first were even harsh and cruel. In these cases, there is, probably, first a period of intense pain, then one of indifference, then a feeling of reconciliation, and, finally, the feeling of attachment which makes itself felt first when there is a threatened break. The illustrations most often cited of the mollifying power of custom are of galley-slaves who refuse to leave their yokes though offered their freedom, and of "men grown old in prison who ask to be readmitted after being once set free." Concerning habit and its power to form attachments to lives called 'hard', James observes: "It alone prevents the hardest and most repulsive walks of life from being deserted by those brought up to tread therein." Illustrations from daily life of attachment to particular ways of acting and thinking which springs up through habit are found in the comfort that grown persons find in old ways of doing things and their resentment when asked to change, and in the familiar experience that the effort to break a habit of long standing is usually a disagreeable one. The principle has a wide range of application. The explanation of all forms of what the younger generation calls 'old fogyism', whether it takes the form of clinging blindly to a grotesque system of spelling, or of cherishing venerable doctrines in the realm of theology, is found in the unwillingness to break with the habitual and customary, and this unwillingness is due to the feelings which cluster about the old ways of thinking and doing.

One other illustration of the influence of habit in the realm of feeling may be mentioned, namely, that feeling-habits of pleasantness or unpleasantness frequently become attached to the memories of particular experiences. For example, students often say that they have acquired an habitual dislike for a given school subject, and that the thought thereof always arouses a disagreeable feeling. In like manner, the feeling which clings to the memory of an unpleasant journey, to that of a house in which we were unhappy, to the thought of a community which ruffled our feelings; in a word, to the memory of any situation which was constantly irritating, becomes set, fixed, habitually disagreeable. On the other hand, the cluster of pleasant feelings which attaches to the thoughts about a true and tried friend, to the name of our favorite author, to the memories of the happy days of childhood, may settle into an habitual feeling mode of pleasantness.

**Feeling and Association.** — Slightly changing one of James' sentences we may say, 'A sensation or idea will infect another with its own feeling tone when they have become associated together into any sort of a mental whole.' Sensations or ideas which are natively unpleasant may become pleasant and those which are natively pleasant may become unpleasant through association. Sully finds an illustration of this principle in the observation that the cawing of a crow, a sound which is not agreeable in itself, may, because of its associations with pleasant experiences, become highly pleasurable.

"This sound', Sully writes, 'in the case of those who have lived in the country in early life and enjoyed its scenes and its adventures, is well known to become a particularly agreeable one. To some people, indeed, there is hardly any more delightful sonorous effect than that of this rough unmusical call. The explanation is that this particular sound, having been heard again and again among surroundings, as park and woodland, which have a marked accompaniment of pleasure, has become contiguously interwoven with these presentations, and so produces a faint re-excitation of the many currents of enjoyment which accompanied these."[1]

So, also, the crude music of a hand-organ may not be in itself pleasant; but to the person who in childhood sang and danced to its simple melodies, the tones may revive joyous memories, and so be pleasing.

"Why," asks Ebbinghaus, "is a sunny spring landscape usually more pleasant than the same view in winter?" and answers, "partly because the coloring of the former is pleasanter; but chiefly because the ideas associated with the one are pleasurable and those associated with the other are unpleasurable. The spring landscape reminds one of life, warmth, travel, and picnics; the winter scene suggests death and decay, cold, moisture, overheated and ill-ventilated rooms."[2]

Transferrence of Feeling. — Closely connected with the fact of the arousal of feeling through association is the so-called 'transferrence of feeling', of which the miser's love of money is the accredited illustration. At first, the money is valued as a means of securing desired objects; but, after a time, the feel-

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[1] *The Human Mind*, 1892, Vol. II, p. 78.

[2] *Psychology*: Eng. trans. by Meyer, § 19.

ing attaches to the money itself, independently of the ideas of its uses. Or, to take a simpler case, suppose that you frequently associate, in your thinking, a given color with a building or a garment which you particularly dislike; then it is likely that the color itself will be displeasing to you, wherever it occurs and quite apart from its earlier relations. The feeling is transferred from the original object as a whole to one of its attributes or associates.

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# CHAPTER XIV

## EMOTION

The term 'emotion' denotes such mental experiences as fear, anger, joy, grief, envy, sympathy, pride, humility, and their like.

The present chapter includes, first, a brief description of the distinguishing feature of the emotions, i. e., the characteristic that serves to mark them off from all other mental processes; second, an enumeration of the essential factors of an emotion; third, a study of the 'James-Lange theory' of emotion; fourth, an outline of current theories as to the origin of the emotional reactions.

**The distinctive mark of Emotion.** — The characteristic of the emotions is found in the meaning of the Latin *emovere* (to shake, to stir up), from which the term 'emotion' is derived. A state of emotion is essentially a state of excitement, of agitation, of disturbance, of perturbation. This is conspicuously true of the stronger emotions like rage and terror, but it is also true of the quieter emotions whose outward signs are often slight and unnoticeable. Our common expressions, 'pent up anger', 'smoldering jealousy', 'choked pity', 'curbed emotion', and many more like them, indicate that, in our everyday thinking, a fully developed emotional process is conceived to be essentially a state of perturbation or excitement.

**The Factors of an Emotion: (1) Organic Sensations.** — This mental agitation, which, in our view, is the distinguishing feature of the emotional experience, is due, in part, to the fact that the components of the emotional complex vary greatly in intensity from moment to moment, and are constantly changing, often with great rapidity, their relations to one another and to the total conscious state. It is due in the main, however, to the presence of a special set of sensations which originate in the various bodily organs (respiratory, circulatory, digestive, motor, and glandular) when an emotionally exciting object or idea is present to consciousness; moreover, the consciousness caused by these bodily changes (in heart-beat, breathing, glandular action, muscular rigidity, and so on) gives to the various emotions their characteristic coloring; in fact, in the opinion of many psychologists, constitutes in itself the whole of the emotional experience.

Darwin's description of the bodily reaction to fear exciting objects affords a good illustration of the large place which bodily commotion and its resulting sensations occupy in our emotional experience.

"In fear', Darwin writes, 'the eyes and mouth are widely opened and the eyebrows raised. One stands like a statue, motionless and breathless, or crouches as if to escape observation; the heart beats quickly and violently, so that it palpitates or knocks against the ribs; perspiration exudes from the skin, the hair stands erect, the superficial muscles quiver, and the salivary glands act imperfectly; the mouth becomes dry . . . . and the voice husky or indistinct, or may altogether fail."[1]

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[1] *The Expression of Emotions*, 1905, p. 289 f.

Or take, as another illustration, the same author's description of the symptoms of rage: "The heart and circulation are always affected; the face reddens or becomes purple, with the veins on the forehead and neck distended. . . But sometimes the action of the heart is so much impeded that the countenace becomes pale; the respiration is affected; the chest heaves and the dilated nostrils quiver. . . . . The muscles become rigid, the body stiffens, the mouth is generally closed with firmness, the teeth are clenched or ground together, the fists are clenched as if to strike the offender. . . . . But the muscular system is often affected in a wholly different way; for trembling is a frequent consequence of extreme rage; the paralyzed lips refuse to obey the will, and the voice sticks in the throat, or it is rendered loud, harsh, and discordant. If there be much and rapid speaking, the mouth froths," etc., etc.[2]

These quotations, supplemented by what every student may easily observe in his own emotional experiences, and in the signs of emotion in others, will be sufficient warrant for the statement that the disturbance of the various bodily organs is a prominent feature of every emotional reaction. Indeed, so prominent is this feature that many psychologists, as has been remarked already, regard the consciousness caused by these organic changes as the sum and substance of the emotional state. Leaving aside, for the time being, further consideration of this latter view, we may inquire what factors besides the organic resonance are present in the emotional process.

(2) Feeling. — Besides the sensations arising from bodily changes, an emotion includes, as a rule, a

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[2] *Op. cit.* pp. 74, 238 f.

clearly marked feeling factor whose relation to the total emotive process calls for brief notice.

Prior to the publication of the 'James-Lange theory' which, in its original form, teaches that emotions consist of reflexly excited organic sensations, the emotions were classed as feelings; and even yet, in popular speech, feeling and emotion are not clearly distinguished. Thus we have such expressions as, 'feeling of fear', 'feelings of anger, grief, joy, pride, etc.', although, as we have seen, fear, anger, and the rest are emotions.

Now the popular identification of feeling and emotion points to the fact that, in many emotions, the feeling aspect, just because it is feeling, is so prominent that the consciousness of the exciting object and the sensations from bodily changes are obscured. For example, in fear or grief, if intense, the feeling aspect is so conspicuous that the other mental factors are over-shadowed. In other emotions, e. g., scorn, contempt, humility, expectation, surprise, the feeling factor is not marked, and it is often difficult to say whether these emotions are pleasant or unpleasant. In short, emotions are usually either definitely pleasant or unpleasant; but the feeling aspect may vary, all the way from being practically non-existent to an intensity in which it over-shadows all other conscious factors in the process.

If now it be asked, whence comes the pleasantness or the unpleasantness of an emotive state, our answer would be — mainly as an accompaniment of the organic sensations themselves; that is, the characteristic quality of pleasantness or unpleasantness which accompanies the bodily sensations aroused by an emotionally exciting object constitutes the feeling-tone of the emotion. For example, certain sensations from the organs of circulation, respiration, digestion, the throat, skin, muscles, when combined in a given way, form an essential part of the emotion of fear, and also condition its unpleasantness. On the other hand, smiles and laughter, increased heart-beat, heightened activity of the muscles, wide-open eyes, head erect, dancing about, clapping the hands, stamping, loud laughter, are at once causes and signs of the pleasantness of a joyful experience.

(3) Consciousness of the Exciting Object. —A third factor of the normal emotional experience is the consciousness, of varying clearness, of the exciting object. Our fears, angers, loves, jealousies, always have, under normal conditions, an object of some sort of which we are more or less clearly conscious. We are angry at, or toward or about some one or some thing; we fear some person, or agency, or object, real or imaginary.

It is said that in some forms of insanity, the patients experience 'objectless emotions'; they have emotions of grief or fear or anger, or joy or pride, with their characteristic organic perturbation and their appropriate feeling-tone, but deny that their grief, fear, joy, is *about anything;* they are just sad, frightened, joyful, and that's all there is to it. However it may be with these unfortunates, the emotions of normal persons are felt in reference to objects.

The James-Lange Theory of the Emotions. — Common-sense says that our emotions precede and *cause* the so-called expressions of emotion; that when, for example, we receive good news, we feel joy, then express our joy by smiles and laughter, by clapping the hands, by the light, elastic step, and so on — the latter being called "expressions" of the joyful emotion; that if, when alone at night in a deep forest, we hear a strange cry, we feel fear, then the fear expresses itself in the trembling muscles, the accelerated heart-beating, the suspended respiration, and other bodily changes. In a word, the phrase 'expression of the emotions' incorporates the common-sense view of the relation of emotion to its expression. The James-Lange theory, on the contrary, is, in James' words, "that the bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur *is* the emotion. Common-sense says, we lose our fortune, are sorry and weep; we meet a bear, are frightened and run; we are insulted by a rival, are angry and strike;" [1] whereas the James-Lange theory is that the bodily changes (the weeping, or running, or striking) *precede* the emotion, and that the consciousness aroused by these changes *is* the emotion — the sorrow or fear or anger.

Since this theory is at present the prevailing one, and since it forms the starting point, or at any rate a prominent feature, of almost every modern discussion of the emotions we shall do well to consider briefly what may be said for and against it.

The arguments upon which this theory rests are the following as stated, in substance, by James:

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[1] *Principles of Psychology,* Vol. II, p. 449 f. See also, *Psychological Review,* Vol. I, 1894, p. 516-529.

(1) Particular perceptions certainly do produce instantly wide-spread bodily effects, antecedent to the arousal of an emotion. If, for example, while walking we suddenly come upon some fearful object in our path, say a snake, a bodily commotion occurs immediately and reflexly, and before an idea of danger can arise; moreover, the consciousness of this perturbation seems to be the most conspicuous feature of the total experience.

(2) "In every asylum we find cases of absolutely unmotived fear, anger, melancholy, etc." In such cases the emotion is not caused by the objects in the patient's environment, nor by his present images and thoughts, yet it exists in a character as real and as formidable as if it followed in the wake of an appropriate perception or idea. James' theory is that these 'objectless emotions' are induced directly by bodily changes whose effects in consciousness *are* the emotions of fear, anger, dread, or what not.

(3) "Every one of the bodily changes, whatsoever it be, is felt acutely or obscurely the moment it occurs. . . . . Thus a contraction of the eyes and brows, often inconsiderable, is felt when one is worried by any slight trouble; and when momentarily embarrassed it is something in the pharnyx that compels either a swallow, a clearing of the throat, or a slight cough; and so on for as many more instances as might be named."

(4) "The vital point of my whole theory," James writes, "is this: If we fancy some strong emotion and then try to abstract from our consciousness of it all the feelings of its bodily symptoms, we find we have nothing left behind, no 'mind-stuff' out of which the emotion can be constituted, and that a cold and neutral state of intellectual perception is all that remains. . . . . What kind of an emotion of fear would be left if the feeling neither of quickened heart-beats, nor of shallow breathing, neither of trembling lips nor of weakened limbs, neither of goose-flesh nor of visceral stirrings, were present, it is quite impossible for me to think.

. . . Every passion in turn tells the same story. A disembodied human emotion is a sheer non-entity."[1]

**Objections to the James-Lange Theory.** — A view which thus runs counter not only to common sense, but also to the teaching of psychology for centuries, quite naturally has aroused a wide-spread discussion, much of which takes the form of opposition to the theory. Some of these objections, particularly those raised by Wundt and Stout, may now be reviewed.

Wundt's objections. (1) "The definite outer symptoms of emotions do not appear," Wundt maintains, "until such time as the psychical nature of the emotion is already clearly established. The emotion, accordingly, precedes the innervation effects which are looked upon by these investigators [James and Lange] as causes of the emotion." The answer to this objection is that the James-Lange theory does not hold that the definite *outer* symptoms appear prior to the emotion; the rather does it lay stress on the bodily changes which occur in the inaccessible, hidden parts of the organism, those which are inner and not open to observation, as the physical basis of the emotions, though, of course, according to this theory, the more violent emotions are dependent, in part, upon the conspicuous 'outer symptoms' to which Wundt refers.[2]

(2) "The psychical processes [emotions] are much more varied than are their accompanying forms of expression." Wundt holds, in other words, that the variety of mental states called emotions is much greater than the possible variations of organic response which the James-Lange theory

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[1] *Principles of Psychology,* Vol II, p. 450 ff; also, *Psychology,* p. 376 ff. A corollary of James' theory is, "that any voluntary and cold-blooded arousal of the so-called manifestations of a special emotion should give us the emotion itself. Now," James continues, "within the limits in which it can be verified, experience corroborates rather than disproves this inference."

[2] *Outlines of Psychology,* 1907, § 13, p. 195 f.

requires. James, in a measure, anticipated this objection by the statement that, "The various permutations of which these organic changes are susceptible make it abstractly possible that no shade of emotion should be without a bodily reverberation as unique, when taken in its totality, as is the mental mood itself." Now it is clear that these opposing statements do not settle the issue; they merely define it. James held that the forms of bodily expression may be as varied as are our emotional experiences; Wundt says they are not, and the question remains pretty much where these authors left it.

(3) "The physical concomitants stand in no *constant* relation to the *psychical quality* of the emotions. . . . . . It may sometimes happen that emotions with very different, even opposite, kinds of affective contents, may belong to the same class so far as the accompanying physical phenomena are concerned." This again raises a question of fact, viz., do the same changes in the muscles, heart-beat, breathing, glandular action, and so on, accompany a given emotion, fear, e. g., on one occasion, and on another, a different emotion, or even one opposite in character, e. g., courage? It does not seem that such is the case; casual observation seems to show conclusively that a change in the nature of the bodily reaction is accompanied by a change in the emotional experience; moreover, that in the individual experience, the relationship between the organic changes and the quality of the emotions, including their 'affective contents," is constant.

Stout's objections. Stout raises two objections to the James-Lange theory, which are more serious, in the present writer's judgment, than those just considered.

Stout's first objection relates to the constitution of the emotive process. He maintains that while it may be impossible for an emotion to exist without the organic sensations, it does not follow that they constitute the whole of the emotion. In other words, Stout, while admitting that organic sensation is an essential factor in the emotional state, holds that it is not the sole factor; that an emotion is a complex experience and includes, besides organic sensations, conative tendencies, and a feeling of pleasantness or unpleasantness according as these tendencies are favored or hindered. Thus we have, in this writer's view, sensations, conative impulses, and a feeling of pleasure or pain, as distinguishable aspects of the total emotional state.[1]

Altogether, it seems better to widen the scope, or meaning, of the term emotion, as Stout does, and to include under it, in addition to the consciousness due to particular kinds of bodily commotion, also the consciousness of the exciting object and a characteristic feeling tone, to which Stout adds — impulses to action.

A second objection raised by Stout relates particularly to the order of appearance of the factors in an emotional experience; this, too, involves a radical difference in theory. In order to illustrate Stout's thought, suppose the case of a person walking at night along a city street, when suddenly a highwayman jumps from a dark alley, thrusts a pistol in the victim's face, and commands, 'Hands up!' Instantly, there is an intense and diffused disturbance of nervous equilibrium. Now this primary disturbance involves both the brain itself and the nerves leading to different parts of the body, and "the question is whether this primary neural disturbance is itself correlated with consciousness of an emotional kind, or, at any rate, with consciousness which forms an

[1] *A Manual of Psychology*, 1899, p. 289 ff.

essential constituent of the complete emotion."[1] In answer to this question, Stout maintains that 'the primary nervous excitement', including changes within the brain itself and those changes in the nervous system due to the diffusion of the nervous discharge, is itself accompanied by a mental disturbance which is an essential feature of the emotion; and further, that this mental excitement precedes, in time, the excitement due to the onrush of reflexly excited impulses from other bodily organs. The present writer agrees with Stout on this point; but he agrees with James in regarding the consciousness that is immediately dependent upon the commotion in the bodily organs as the most important part of the emotional experience, and as the factor which, more than any other, serves to mark off the emotions from all other mental phenomena.

The Genesis of Emotional Reactions.[2] — We have seen that the core of each particular emotional expeperience consists of organic sensations of a given character, number, intensity, and form of combination. Fear, for example, derives its distinctive feature from one set of bodily sensations; anger, from another; joy and grief, from still others. We have now to ask, how comes it that for a given organism, each emotionally exciting object awakens its own specific kind of bodily commotion and no other? how comes it, for example, that one situation pro-

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[1] Stout, *op. cit.* p 297, note.

[2] On this topic, the student should read Dewey's articles in the Psych. Rev., Vols I and II, wherein he undertakes to bring into 'organic connection' 'Darwin's principles as to the explanation of emotional attitudes, and the James-Lange theory of the nature of emotion'.

vokes organic changes, the consciousness of which forms the characteristic feature of the experience called anger? and that others arouse the reactions characteristic of fear, joy, disgust, pity, grief, and so on?

It may be said at once that the question regarding the origin of our various emotional reactions is, in large measure, essentially the same as that concerning the origin of our instinctive reactions; that the question, why do given objects elicit such special kinds of emotional response? bears a very close resemblance to such inquiries as, how shall we explain the extraordinary clinging power of newly-born infants? or why do bitter tasting substances call forth grimaces? and how comes it that as the child passes from infancy to maturity, half a hundred or more instinctive actions, i. e., actions which are 'naturally provoked by the presence of specific sorts of outward fact', make their appearance? And the answer in both cases is that these reactions are due mainly to the individual's inherited tendencies. Our first step, then, in accounting for our emotional reactions is to assume that the principal ones are 'innate or inherited — that is, have not been learned by the individual.'

But this statement is very general, and sheds little or no light upon the problem concerning the influences operative in the course of organic evolution which gave rise to the particular relationship which now exists between situations of a given nature and our particular emotional responses thereto. In order to provide at least a partial answer to this question, Spencer, Darwin, and others have formulated a number of principles which admit of a wide variety of applications, as is seen most fully in Darwin's work on *The Expression of the Emotions.*

Three of the most important of these principles may now be considered in turn. The first of these, to employ James' words, is "the principle of revival in weakened form of reactions which formerly (when they were stronger) were useful in more violent dealings with the object inspiring the emotion."[1] Darwin's fuller statement of this principle, slightly modified, is as follows:

"When any object has led, during a long series of generations, to some voluntary movement, then a tendency to the performance of a similar movement will almost certainly be excited, whenever the same or a similar object is present to consciousness. Such habitual movements are often or generally inherited; and they differ but little from reflex actions."[2]

This principle, which, for the sake of brevity, may be called 'the principle of waning utility', is employed by Darwin and others to explain a large number of emotional reactions (responses) in man and the lower animals. The expression of fear, e. g., is explained in part by this principle, as follows:

In past ages, man's endeavor "to escape from his enemies or danger, either by headlong flight, or by violently struggling with them, . . . . caused the heart to beat rapidly, . . . . . . the chest to heave, and the nostrils to be dilated. As these exertions have often been prolonged to the last extremity, the final result would have been utter prostration, pallor, perspiration, trembling of all the muscles, or their complete relaxation."[3]

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[1] *Op. cit.*, p. 478 f.

[2] *The Expression of the Emotions*, 1905, p 48.

[3] *Op. cit.*, p. 307.

So at the present time, because of these ancestral experiences, the same results in the form of nascent tendencies to flight, or crouching, the pallor, etc., tend to reappear as reminiscent echoes, when the man of today is in the presence of a fear provoking situation. Again, the protrusion of the lips, so often seen in children and highly emotional adults,— sometimes as a sign of sulkiness, or disappointment or surprise, sometimes when slightly pleased — is, so Darwin surmises, also a reversion to a primordial expression which appeared in our semi-human progenitors' reactions to disappointing or surprising or pleasing situations. In like manner, the upward curl of half the upper lip in the playful or defiant sneer or in the ferocious snarl is a descendant, in weakened form, of the habit possessed by our semi-human progenitors of unfleshing their canine teeth when prepared for battle.

(2) Many emotional reactions are attributed by Spencer, Darwin, and others to the undirected overflow of nervous energy throughout the nervous system which many stimuli, particularly strong ones, cause. Among the effects ascribed wholly or in part to the diffusive excitement of the nervous system are — the cold sweat, the dryness of the mouth, and the trembling of the muscles in fear; the 'lump in the throat' in grief; the disturbance of the functions of the liver and kidneys, the modified secretions of the intestinal canal, the changes in the heart-beat and breathing, in all the stronger emotions. So also the senseless and frantic actions of an enraged man may be attributed in part to the undirected overflow of nerve force. This princple

seems also to explain the strong tendency to various purposeless movements and the utterance of various sounds under a transport of joy, rapture or ecstacy. "We see this', Darwin writes, 'in our young children, in their loud laughter, clapping of hands and jumping for joy. . . . The above purposeless movements and increased heart-action', Darwin continues, 'may be attributed in chief part to the excited state of the sensorium, and to the consequent undirected overflow, (as Mr. Herbert Spencer insists) of nerve-force."[1] These examples will suffice to illustrate the general statement that many emotional responses "are in large part directly due to the disturbed or interrupted transmission of nerve-force from the cerebro-spinal system to various parts of the body."

(3) If, in accordance with the first principle stated above, certain situations regularly call forth reactions of a given kind, there will be, according to the principle of antithesis, a strong and involuntary tendency to react in an opposite manner under the excitement of an opposite kind of situation. This principle, which relates particularly to the functioning of the muscular system, is useful in accounting for the opposite sensations of strain and relaxation which form so prominent a feature of many emotions. Thus, the sensation of strain forms a conspicuous factor of such emotions as anger (in its various forms) astonishment, hope, anxiety, defiance, jealousy, indignation, pride, scorn, while the

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[1] *Op. cit.*, pp. 76, 307.

sensations of relaxation are prominent in dejection, despair, grief, humility, helplessness, sulkiness. In like manner, the body erect, the squared shoulders, the expanding chest, the clenched fists, the frown, the firmly set jaws, of the indignant man yield a set of strain sensations which stand clearly opposed to the sensations of relaxation which belong to the emotions of regret or penitence. Again, the high head, the lofty carriage, the puffed-up demeanor, the strutting of pride, furnish, it need hardly be argued, a fund of strain sensations which stand in strong contrast to sensations of relaxation which are features of humility.

The three principles thus far enumerated afford a partial explanation of the origin of inherited, or innate, emotional reactions. A fourth principle, that of habit and association, relates more particularly to the development of emotional responses in the individual experience. This principle is that reactions which have become associated with given objects are repeated in weakened form on the appearance of similar objects. For example, the signs of disgust—the movements of the mouth, the frown, gestures as if to guard oneself against the offensive object, a sound as if clearing the throat, incipient retching, spitting, a slight shudder and so on — which are excited by present objects that are offensive to taste or smell, will from habit arise at the image or idea of the offensive object or at the idea of actions or objects which would, if present to sense, be offensive. Again, the movements around the nose and mouth expressive of contempt, sometimes accompanied by a slight snort or expiration, are the same as those which follow the perception of an offensive odor and the wish to exclude or expel it. So in contempt, "we seem to say to the despised person that he smells offensively, in nearly the same manner as we express to him by half-closing our eyelids, or turning away our faces, that he is not worth looking at. It must not, however, be supposed that such ideas actually pass through the mind when we exhibit our contempt; but as whenever we have perceived a disagreeable odor or seen a disagreeable sight, actions of this kind have been performed, they have become habitual or fixed, and are now employed under any analogous state of mind."[1]

Summary. In our study of Emotion we have seen —(1) that mental perturbation is the characteristic feature of the emotional state; (2) that every fully developed emotion includes as its chief factors (a) a plexus of organic sensations, (b) a feeling of either pleasantness or unpleasantness, (c) a consciousness, of varying clearness, of the emotion's object; (3) that the James-Lange theory must be modified so as to take account of all of the factors just enumerated; (4) that the principles (a) of waning utility, (b) of diffused excitement of the nervous system, (c) of antithesis, and (d) of habit and association, afford a partial explanation of the genesis of emotional reactions in the species and in the individual.

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[1] DARWIN, *Op. cit.*, p. 255 f.

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# CHAPTER XV

## THE SENTIMENTS

**Meaning of the Term 'Sentiment.'** — The term 'sentiment', like so many others which the psychologists employ, is used in a great variety of meanings both in the language of everyday life and by the psychologists themselves. Sometimes it is used loosely as the equivalent of either belief, view, judgment, body of doctrine or a declaration of faith, as when one says in respect to a given opinion, view, or body of principles, 'this is my sentiment', 'this is the sentiment of our party or of our community.' Sometimes it means something unreal, fanciful, as opposed to the real, genuine, substantial, as when one ridicules another's interest in music or literature or religion by saying, "it is a mere sentiment with him; he doesn't take it seriously." Most frequently, however, the term is used as the equivalent of emotion; thus, one speaks of the tender, the amiable, joyful sentiments, and of those which are angry, envious, or ugly, when the speaker usually means amiable, tender, joyful, angry, etc., emotions.

In this chapter we shall mean by 'Sentiment' (following two English writers)[1] a relatively permanent emotional attitude, or disposition, in respect to a given object or class of objects which is assumed

[1] SHAND, Character and Emotions, *Mind*, N. S. Vol. V, p. 214 ff; STOUT, *A Manual of Psychology*, 1899, pp. 300, 575 ff.

to be helpful or harmful, valuable or valueless, worthy or unworthy; in other words, a sentiment is an emotional attitude which attaches to a value judgment, i. e., a judgment regarding the value, from the point of view of the person who utters it, of a given object. Three points of this definition should be noted: (1) a sentiment involves a judgment of worth in regard to a given object or group of objects; (2) it includes the feeling and the reflexly excited organic sensations that are characteristic of its closely related emotions; (3) it is a relatively permanent mode of consciousness, it is a complex mental habit. Under the term sentiment, thus defined, we should include "affection for our friends, the home sentiment, and every sentiment we can use the term 'love' to express, as love of knowledge, art, goodness, love of comfort, and all our interests, as interest in our health, fortune and profession, interest in books, collections," and so on. We should include also every fixed tendency we can use the terms dislike or hatred to denote, and many more besides, since every kind of emotional reaction, if oft repeated, tends to develop into a fixed emotional attitude, or sentiment.[2]

**Sentiment and Emotion Compared.** — The sentiments are distinguished from the emotions in four principal ways: (1) Broadly speaking, the former are pre-eminently human experiences, while the

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[2] This definition of 'sentiment' seems to give due prominence to those meanings which the term bears in literature and in everyday speech; and it also enables us to mark it off from the terms 'feeling' and 'emotion.' * * * Other equivalents of the word 'sentiment' are 'interest,' 'emotional disposition' or 'attitude.'

emotions are shared in by man and the lower animals. This rough distinction of the sentiments as human experiences and the emotions as animal, is clearly valid in respect to the abstract sentiments on the one hand, and in respect to the 'coarser emotions' on the other. No animal, however noble, knows anything of the sentiments of 'duty', 'justice', 'reverence', and the like; but many animals share with man the emotions of fear, anger, joy, grief — which are fittingly called, by some writers, the 'animal emotions.'

It is no doubt true that a dog's fondness for his master has points of similarity to the master's affectionate regard for his old home, his native town, or his friends; and both are instances of the attachment which arises in regard to those features of an environment to which one is accustomed. But the two differ in that the man's sentimental interest may be based, in part, upon ideas of worth which attach to the objects of his regard, while the dog's fondness for his master is based wholly upon the pleasurable sensations of being fed, petted, and the like. It is also true that many emotional experiences are entirely foreign to the lower animals, e. g., admiration for ideal goods like truth, beauty, goodness, the emotions of envy, scorn, sympathy, hope, and many others which are distinctly human affairs. And yet in a broad way, we may think of the sentiments as characteristically human experiences, and that man and the lower animals are joint tenants in the territory of the emotions.

(2) The sentiments are relatively permanent attitudes toward certain objects, or groups of objects, whereas the emotions are transitory in character. A sentiment abides; an emotion runs its course and vanishes. For example, the sentiment of patriotism

is a relatively stable attitude; to say of one's patriotism that it is emotional is to imply that it is fickle, spurious, lacking in permanent worth. In like manner, the sentiment which attaches to one's ideas of duty is a fixed characteristic of one's nature; it is either ridicule or a reproach to describe a person's sense of duty as emotional. The sentiments are relatively permanent, while the emotions come and go.

Stout has this distinction in mind when he says that the difference between emotion and sentiment is to a large extent a distinction between dispositions and actual states of consciousness. "Such a sentiment as friendship', Stout continues in substance, 'cannot be experienced in its totality at any one moment. It is felt only in the special phase which is determined by the circumstances of the moment. The sorrow of parting from a friend and the joy of meeting him after a long absence are actual experiences; but the sentiment which includes the susceptibility to either, according to circumstances, cannot in its totality be an actual experience. It is a complex emotional disposition which manifests itself in actual emotions. The sentiment, so far as actual experience is concerned, is constituted by the manifold emotions in which it manifests itself."[1]

(3) We have seen above that many of our emotional responses are innate; the sentiments, on the other hand, are acquired; they are built up out of a multitude of feeling-emotional responses, and require a period of growth. This is obviously true of such sentiments as love of justice, loyalty to one's family or school, devotion to science or art, and the like. Some of these are developed in the course of education by teachers and parents, some

[1] *A Manual of Psychology*, 1899, p. 578.

of them grow up without conscious purpose on any one's part, partly by imitation, partly by absorption from the fund of common sentiment.

Apparent exceptions to the general statement that the sentiments develop slowly are found in those instances in which some single, impressive experience fixes a deep and lasting sentiment, as when Saul of Tarsus was transformed from a persecutor of the Christians to the most powerful preacher of the new doctrine; or in the case of Lincoln who suddenly became possessed of a deep hatred of human slavery when, as a young man, he chanced to visit a certain slave market. These exceptions, however, are only apparent, for doubtless in the case of both St. Paul and Lincoln, a multitude of experiences had prepared them for the overpowering sentiments which were henceforth to dominate their lives.

(4) The sentiments lack the organic commotion, the surging, the rush and turbulence, which are characteristic of many emotions. And yet, while this difference is clear, the sentiments are not merely cold, intellectual perceptions that certain things are true, or good, or beautiful, or praiseworthy. With slight changes, James' statement in respect to the 'bodily reverberation' as an aspect of the moral, intellectual and æsthetical feelings — the subtler emotions — applies also to the sentiments:

"In all cases of intellectual or moral rapture we find," he says, "that unless there be coupled a bodily reverberation of some kind with the mere thought of the object and cognition of its quality; unless we actually laugh at the neatness of the demonstration or witticism; unless we thrill at the case of justice, or tingle at the act of magnanimity; our state of mind can hardly be called emotional at all."[1]

[1] *Principles of Psychology,* Vol. II, p. 470.

So we may say of the sentiments that although they lack the organic resonance and the mental perturbation which characterize the emotions, they still have, in Ladd's words, "a sensuous coloring from the changes in the concomitant condition of the peripheral and intra-organic vessels and tissues." This is as one would expect when one recalls that the sentiments are the final resultants, the precipitates, of multitudes of emotional experiences; they too are tinged by the influence of the earlier emotional reactions.

The sentiments which are called 'warm' or 'glowing' show most plainly the presence of the organic factor. In illustration take Ladd's description of the sentiment of sublimity:

> "That is sublime," Ladd writes, "which is lifted up on high; and that is sublime to me, to which I am conscious, in some way, of being drawn or lifted up, or allured to make the effort of lifting myself up. Such an experience cannot, however, be had with any warmth of feeling — that is, there can be no actual psychosis corresponding to the sentiment of the sublime — without the appropriate psychophysical activity. This activity includes . . . . the deeper inspiration, the quickened circulation, the tendency to widen the extent of the heart movement, etc. . . . . The effort to repress this mild and massive bodily resonance . . . . tends at once to diminish this characteristic form of feeling [sentiment.] Its presence is undoubtedly felt in all experience with this sentiment. Moreover, the different shadings of the sentiment are, to a large extent, obtained only by differentiations in the characteristic tone of the bodily resonance.[1]

Shand, in the article referred to above, points out one other relation between sentiment and emotion,

[1] *Psychology: Descriptive and Explanatory*, 1899, p. 562 f.

which we may notice briefly. We have seen in a foregoing paragraph that the sentiments are outgrowths of our emotional experience. Now Shand calls attention to the fact that "sentiments, when they have once come into being, are themselves independent sources of manifold feeling attitudes and conations [emotional reactions], varying with varying circumstances. They are complex mental dispositions, and may, as divers occasions arise, give birth to the whole gamut of the emotions."[2] For example, "in the love of an object," Shand writes, "there is pleasure in presence and desire in absence . . . . fear in the expectation of its loss, injury or destruction . . . . anger when the course of our interest is opposed or frustrated . . . . regret in the loss, injury, or destruction of the object, joy in its restoration or improvement, and admiration for its superior quality or excellence. And this series of emotions — as episodes in the life-history of the sentiment — occurs now in one order, now in another, in every sentiment of love or interest, when the appropriate conditions are present."[2]

We have given in the preceding paragraphs a brief description of sentiment as an emotional attitude, and we have indicated certain ways in which it differs from and is related to emotion. We may turn next to a group of phenomena which, in the history of thought, have been regarded as the characteristic sentiments, namely, those emotional attitudes that attach to the ideals of truth, beauty, and

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[1] STOUT, *The Groundwork of Psychology*, 1903, p. 224.
[2] *Manual of Psychology*, 575 ff.

goodness. They are usually referred to as the intellectual, æsthetic, and ethical, or moral, sentiments. In what follows, we shall be interested most in the order and conditions of the development of these sentiments in the individual.

**The Intellectual Sentiments.** — The intellectual sentiments are those permanent emotional attitudes which are developed in respect to knowledge, or truth, as something worthy in itself. These sentiments are designated by a variety of expressions, the most common of which are, "the love of knowledge for its own sake," "refined intellectual curiosity," "the feeling of the value of truth in and for itself," "the pleasures of knowledge," "devotion to science," and others of a similar purport.

If we were to search out the sources, the most primitive forms from which an individual's intellectual sentiments spring we should come upon the sensational curiosity, or hunger, of infancy, i. e., those impulses, which are so striking a feature of every normal baby's behavior, to see, hear, touch, handle everything in his environment; we should also be struck by the evident pleasure which accompanies the gratification of these impulses. A little later, appears the absorbing interest in whatever is new or strange, the childish wonder at all things marvelous. Then comes the delight in acquiring knowledge about all sorts of things — the objects of nature, heroes and their achievements, historical events, politics and government. This is a period of disinterested curiosity, the period when the pupil's native eagerness for knowledge is the pride and the delight of teachers and parents. It is now that education may well be conceived of as, in part, a process of nourishing, directing, strengthening, and refining the pupil's intellectual interests. Then, later, the youth begins to see the practical benefits of a well-stored mind, the distinction which comes to 'the man who knows', and the practical advantages which the well informed man has over the ignorant one; he may also feel pride in his knowledge as a source of strength, and shame in his ignorance since it means weakness. He is now at the age to believe that 'knowledge is power', and that it is valuable because it does give its possessor practical advantages in the struggle for position, influence, riches, and fame. This is the stage at which most seekers after knowledge stop. Knowledge for them is good, but it is good only as a means to some other end.

So far there is little of the love of knowledge as a sentiment or passion. The nearest approach to it is found in the intellectual avidity of childhood and youth, but this is too concrete, too much in regard to particular things, and too evanescent to be called an intellectual sentiment. The last stage is reached only by the exceptional minds. Only a few choice spirits in each generation, even among the most enlightened peoples, ever come to care deeply for knowledge as a good in itself; and these are our scholars, philosophers, and our heroes of scientific research; those who like Bacon, Newton, Kant, Darwin, and Helmholtz, devote their lives to the pursuit and interpretation of known truth and to the extension of the boundaries of human knowledge.

There can be no doubt of the genuineness of this sentiment or of its nobility as a controlling interest in the lives of many who profess it. And yet, as Ladd remarks, "a purely sentimental feeling toward a fictitious creature of imagination called 'science', or a secretive and miser-like eagerness to acquire and hoard facts, are affective phenomena which . . . . are almost pathological in character." As illustrative of the 'secretive and miser-like eagerness to acquire and hoard facts', one thinks of the hermits found in almost every age and land, who like the Hungarian, Mentelli, philologist and mathematician, without a definite end in view, simply for the pleasure of learning and to satisfy their intellectual cravings, devote their entire lives to study, having apparently no other aims.

Mentelli's case is typical enough of a class, much larger than is generally known, of intellectual misers living in voluntary exile and spending all their time and strength in study, to warrant a brief quotation from his biography as it is reproduced by Ribot, as follows:

"Living at Paris, in a filthy lodging, the use of which was allowed him out of charity, he had cut off from his expenditures all that was not absolutely necessary to sustain life. His outlay — apart from the purchase of books — amounted to seven sous (cents) a day, three of which went for food, and four for light. . . . All he needed was water which he fetched for himself, potatoes which he cooked over his lamp, oil to feed the latter, and coarse brown bread." Ribot cites Mentelli and others like him as cases "where the love of knowledge alone, untarnished by other motives, has all the characteristics of a fixed and tenacious passion, filling the whole of life, and expressing the whole nature of man." [1]

The Moral Sentiments. — In order to account for the origin and development of the moral sentiments in the individual, we have to consider the action of

[1] *The Psychology of the Emotions*, 1906, p. 373 f.

certain environmental agencies upon certain of the individual's innate tendencies and capacities. Among the child's native tendencies or impulses which may be regarded as the special conditions of the development of the moral sentiments are to be noted — (1) the self-regarding impulses, the individualistic instincts, love of pleasant experiences and dislike of painful ones, and (2) the social instincts of sympathy, the impulse to echo the feeling and emotional reactions of others (social responsiveness or sensitivity), the love of approbation and dislike of blame. We assume further that the individual has (a) the capacity to form habits, (b) the ability to profit by experience which latter capacity involves memory, and (c) the power to reject some of the possibilities of action and select, maintain, and strengthen others. The environmental agencies necessary to the development of the moral sentiments are persons, in the rôle of authority, issuing commands, rewarding obedience and punishing disobedience, stamping with approval what the society regards as right, disapproving what it regards as wrong; developing, cherishing all actions which promote the general good of society; smothering, uprooting those which are judged to be harmful; and, in addition, furnishing an example of conduct which is socially acceptable, and also the grounds of its acceptability.

An individual with the endowment of instincts and capacities outlined above, and environmental agencies which act upon these in the way indicated, are the necessary conditions for the development of the moral sentiments in the individual. For purposes of description, this developmental process may be thought of as consisting of four stages. First, is the stage of control by rewards and punishment; second, the imitative stage; third, the stage characterized by fixed habits; fourth, that in which rationalized ethical sentiments are dominant in the individual's behavior.

Two points, however, in respect to the division of this developmental process into a number of periods should be carefully noted: (1) We are not to suppose that these stages correspond in any literal sense to definite age periods in the life of the individual. As a matter of fact, however, the first stage corresponds roughly to the period of infancy and early childhood; the second, to that of childhood and youth; and the age of fixed habits is reached at twenty or twenty-five, while the rule of the enlightened moral sentiments is established somewhat later. But this correspondence is only rough, at best, and is not important for our purposes. (2) It should be observed that the different periods with their characteristic activities and motives to activity over-lap. A given stage is not sharply marked off from those which precede or follow it. Thus, while we may suppose that the moral behavior of many adults is dominated by fixed moral sentiments, we may still doubt that many persons ever completely outgrow the influence of the hope of reward and the fear of punishment.

With this understanding of the terms 'stage' and 'period', we may say that the first stage is one in which the incentives and determinants to given kinds of conduct exist in the form of rewards — usually some sense-pleasure — when the individual's conduct is judged to be good, and punishment — usually corporal—when it is judged bad. It will not be thought by anyone that this mode of controlling the conduct of a child is an effective or economical way of arousing and fostering the moral sentiments — the love of right and hatred of the wrong — in themselves. Moreover, this method, since it appeals merely to motives of prudence, tends, when prolonged, as we are taught by the ethical philosophers, to undermine the moral life; and certain it is that the person who does the good deed and refrains from doing the bad one in order to gain pleasure, in the one case, and to avoid pain, in the other, is far from the blessedness of him 'whose delight is in the moral law.'

The second stage is marked chiefly by the imitative behavior of the child or youth. During this period the individual repeats imitatively innumerable feeling-emotion responses of those with whom he is associated — parent, teacher, companion. The things which cause the tingle of admiration or the shudder of disgust in others arouse the same experiences in him. Their delight is his delight; their abhorrence, his. At this stage, the individual's feeling-emotional responses, in respect to questions of moral behavior, are largely an echo of those of his social leaders. If their responses are worthy, his will reflect in some measure that quality; if they are base, his will be also. It need scarcely be said that this stage is still far from that of the fully ripened character with its funded capital of rationalized moral sentiments.

A third stage is reached when, by dint of repetition, an individual comes to experience habitually the same feelings and emotions in respect to moral ideas, situations, or suggestions. He is no longer controlled wholly by prudential reasons — thoughts of the pleasures and pains which may befall him; nor is he swayed by every turn of emotion in his associates. From habit, certain kinds and ideals of conduct commend themselves to his judgment and awaken a thrill of approval; certain other kinds provoke his censure, and arouse feelings of repugnance or indignation. He may not be able to justify his emotional responses to moral situations, but for good or for ill his character is fixed.

We have traced in outline three stages in the development of the moral sentiments in the individual: (1) the pleasure-pain stage; (2) the stage of imitation; and (3) the period of fixed attitudes in regard to moral questions. A higher stage of development is reached when moral situations not only call forth uniformly a definite body of feeling and emotion, but when the individual can justify his habitual modes of response by referring to ethical standards, when he comes to see that the sort of conduct which the conscience of society commends promotes in some way the general welfare of its members, and that those forms of behavior which are condemned are subversive of the general good. This is the stage of insight into the grounds of one's ethical responses. For example, the sense of condemnation which dishonesty, injustice, and like wrongs arouse is based on insight into the injury they work in society. Consider further the rationalized sentiments which cluster about the Hebrew decalogue. No doubt the Commandments owe part of their power over the minds of men to certain features of the Old Testament account of their deliverance to Moses; but their influence over the more reflective minds grows partly out of the perception that the manner of life which the Commandments enjoin is an essential condition of a people's prosperity.

The more abstract moral sentiments of devotion to duty, the feeling of obligation, reverence for the moral law, grow naturally out of the particular concrete experiences and observations just mentioned. That is, the frequent observation of the beneficent results which follow obedience to the moral law leads, by a simple process of induction to the conclusion that law, in the broad sense, is worthy of admiration and reverence. So of the sentiments which gather about other abstract moral goods or ideals like justice, honesty, benevolence—they arise by a process of generalizing on the basis of a number of concrete experiences.

**The Aesthetic Sentiment.**—The æsthetic sentiment is a permanent tendency or disposition to find enjoyment in the beautiful in its various forms and modes of manifestation. Love of the beautiful, as a sentiment, differs from æsthetic feelings and emotions in much the same way that a habit differs from the individual activities by which the habit is formed; it is a crystalization from a multitude of æsthetical responses.

The æsthetic sentiment, as thus described, is a late attainment of the indivdiual, but its beginnings are found in the little child's pleasure in sense impressions, particularly those of sight and hearing. Even in infancy we find a rudimentary feeling for the beautiful in the responses to various presentations of light, color, and sound. In the opinion of Sully,

> "It is commonly some bit of bright light, especially when it is in movement, which first charms the eye of the novice; the dancing fireflame, for example, the play of the sunlight on a bit of glass or a gilded frame. In some cases it is a patch of bright color or a gay pattern on the mother's dress which calls forth a vocal welcome in the shape of baby 'talking.' In the out of door scene, too, it is the glitter of the running water, or a meadow all white with daisies, which captivates the glance. Light, the symbol of life's joy, seems to be the first language in which the spirit of beauty speaks to the child."

Consequently his delight in colors is not so much a pleasure in the colors themselves as in their brightness; hence the preference of most children for the bright, luminous tints. Later, children show an interest in color as color, and many of them develop color preferences which last throughout life. Later still appears the appreciation of the finer shades and tints and of color combination and harmony.

It is well known that little children are highly sensitive to sound. Sometimes, perhaps nearly always in infancy, sounds serve only to startle and to awaken fear, but at other times, if they are low and soft, and if they occur in rhythmic series, they are pleasing. So delight in simple tunes and melodies, when they are not too loud, is accounted among the native capacities of the normal child; it is the rudimentary form from which are developed all the higher forms of musical appreciation and insight.

It is an open question whether appreciation of color harmony, proportion, balance, symmetry, unity of design, and other elements of artistic composition is inborn or acquired. It seems likely, however, that most persons develop easily and without special training at least a negative appreciation of these formal elements, i. e., they are affected unpleasantly by objects which lack them. Thus, one says, of a work of art, "there is something 'wrong' with that, but I don't know what." Again, the passing throng, though unable to give reasons for their preference, like the one of two adjoining buildings or pictures which embodies all the features of artistic composition and dislike the other which lacks them. But whatever view we may adopt in respect to the innateness of these higher forms of æsthetic appreciation, there can be no doubt that love of brightness, color, rhythm and melody is well-nigh universal and affords the foundation for a very real, if not always highly enlightened, superstructure of æsthetical sentiment.

When we consider the process by which these rudimentary æsthetic tendencies are trained and developed, we find the same laws operative which obtain in the development of the other sentiments.

The child is taught that certain things are beautiful and that certain others are ugly. If example and precept are in agreement, he sees that his leaders take pleasure in the things which they commend to his admiration and that they are repelled by the things which he is told are ugly. Again, the child is praised when his æsthetic judgments accord with those of his elders and he is reproved when they do not. Moreover, an effort is made to smother and to check whatever inborn tendencies the child may have to find pleasure in the æsthetically uncouth, first, by keeping the child's environment free from all things coarse, gross and æsthetically offensive; and positively by beautifying his environment in every way possible. In time, the child's habits in respect to the beautiful and the ugly become fixed; he has acquired a persistent tendency to take delight in the former and to find the latter offensive.

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# CHAPTER XVI

## CONSCIOUSNESS AND ACTION

In chapter III of his *Talks on Psychology,* James outlines the 'old historic divergence of opinion' concerning the function of human consciousness. On the one side are those who tend "to estimate the worth of a man's mental processes by their effects upon his practical life." On the other, are those who cherish the view that "man's supreme glory is to be a *rational* being, to know absolute and eternal and universal truth." . . . . If one accepts and emphasises the theoretical ideal, "abstraction from the emotions and passions, and withdrawal from the strife of human affairs would be not only pardonable, but praiseworthy; and all that makes for quiet and contemplation should be regarded as conducive to the highest human perfection." Whereas, from the practical point of view, "the man of contemplation would be treated as only half a human being, passion and practical resource would become once more glories of our race, a concrete victory over this earth's outward powers of darkness would appear an equivalent for any amount of passive spiritual culture, and conduct would remain as the test of every education worthy of the name."[1] Continuing, James observes that "it is impossible to disguise the fact that in the psychol-

[1] *Talks to Teachers on Psychology,* 1899, p. 23.

ogy of our own day the emphasis is transferred from the mind's purely rational function where Plato and Aristotle, and what one may call the whole classic tradition in philosophy had placed it, to the so long neglected practical side." And in particular, there is, in modern psychology, strong emphasis of the view that our mind's primary function is to aid us in getting along in the world. "Our sensations,' James continues, 'are here to attract us or to deter us, our memories to warn or encourage us, our feelings to impel, and our thoughts to restrain our behavior, so that on the whole we may prosper and our days be long in the land."

It is foreign to our purpose to enter into a discussion of the relative merits or short-comings of these two views regarding the ideal human life, or as to what constitutes the mind's chief function. We may, however, without hesitation accept the teaching that one, and, in point of time, the primary function of consciousness, both for man and for the lower animals, is to guide action in the pursuit of practically useful goods.

We have seen in an earlier chapter that the simplest form of the nervous system, structurally and functionally, consists (1) of sensory cells whose function is to receive impressions from the outside world, (2) of central cells which either absorb, transmit, or redirect the impulses thus received, and (3) motor cells whose function is to arouse activity in the muscles or other bodily organs. We saw also that the general function of the nervous system is to receive impressions from the outer world and to excite the appropriate responses thereto. We have found, moreover, that when we pass from a consideration of the structure and function of the simplest nervous systems to the highest and most complex forms as found in man and the higher animals, that the general outlines of our description still hold good, if amended in one important respect, viz., that in the process of organic evolution the central nerve cells of the lower forms of animals have undergone an enormous increase as regards number, size, complexity of structure and function. That is, we may still say that the nervous system of the highest animals, of man, e. g., consists essentially of organs for the reception of impressions from outside stimuli, of organs of transmission, redirection or modification of the impulses aroused thereby, and of motor cells and fibres which excite action in various parts of the body. Finally, we may repeat that no nervous impulse is ever lost, that every impression received by the nervous system works itself out sooner or later in a modification of our behavior. As Judd remarks:

"Every nervous current must produce some effect before it is dissipated, for a current of energy must do some work, it cannot disappear. The effects produced by nervous impulses are of two kinds. First, the energy may be absorbed in the course of its transmission, in which case it will produce changes in the condition of the nervous tissue, thus contributing to the modification of the structure of that tissue. Second, it may be carried to the natural outlet of all nervous excitations; namely, the motor channels leading to the muscles or other active organs of the body. It will there produce some form of muscular or glandular activity. If it contributes to changes in structure, these changes in structure will ultimately influence new incoming impulses which are on the way to the active organs. We may, therefore, say that directly or indirectly, all incoming nervous impulses are transmitted to the active organs of the body after being more or less completely redirected or partially used to produce structural changes in the nervous organs."[1]

Having recalled these elementary teachings of biology regarding the structure and function of the nervous system, we may proceed to the study of the principal forms of animal activity. For convenience in description we may classify all individual actions, human or brute, as either hereditary or acquired. To the former class belong the automatic, reflex, and instinctive actions; to the latter, the acquired automatisms—activities which have become habitual—and volitionally controlled actions. These five forms of action may be considered in the order named.

**Automatic Movements.** — Our account, in order to be complete, should include at least brief reference to the so-called automatic movements of the organs of respiration, circulation, and digestion, as found in the higher animals. These movements while not directly preceded or accompanied, ordinarily, by consciousness are still the source of a rich variety of experiences. For example, as we have seen in CHAPTER XIV, the sensations and feelings arising from the disturbance of the normal functioning of these organs form a conspicuous and characteristic feature, the body, so to speak, of the emotions as described by James and his disciples. Further, as

[1] *Psychology,* 1907, p. 22.

we have seen in an earlier chapter, these organic processes, as the source of a special group of sensations, affect the 'tone' of our total consciousness. Concerning them and their influence, Stout writes:

"The heart's beat and its modifications, the constriction and dilation of the blood-vessels, breathing, swallowing, the secretion of saliva, and the like, are not normally accompanied by distinctly appreciable sensations. I say *distinctly appreciable* sensations, because, in all probability, they do in their totality contribute to determine the state of consciousness as a whole, giving it a certain tone or modality. But the effects of the various organic processes blend into a vague total experience. Their several effects are not separately appreciable. The most we can say is that, as Dr. Michael Foster puts it, 'if the whole of our abdominal viscera were removed, we should be aware of the loss as a change in our common or general sensibility.'"[1]

Reflex Actions. — Next in order should be mentioned reflex action which may be defined as an immediate and uniform motor response to an appropriate external stimulus. Instances of the more familiar reflexes are, — the expansion and contraction of the pupil of the eye with varying degrees of illumination, a sleeping person's withdrawal of the hand or foot when it is touched, winking or dodging in response to a sudden threatening motion, the infant's clasping and clinging to objects placed in its hand, sneezing and coughing when the mucous membrane of the nose and throat is irritated, the swallowing reflex, and the sucking reflex of infants.

Reflex actions are distinguished from the automatic actions by the immediacy of the purposes

[1] *A Manual of Psychology,* p. 126 f.

which they serve, and by the fact that their stimuli are usually outside the organism. Thus under normal conditions a threatening motion calls emphatically for immediate action, and the response, unless suppressed, occurs at once. The fact that the stimuli to reflex action usually lie outside the organism does not seem to require illustration.

Reflex actions are classified by Stout and others as either pure reflexes or sensation-reflexes. A *pure*, or physiological, reflex is one which is not accompanied by a definite change in consciousness. For example, the pupillary reflex is wholly unconscious; so, also, probably, are the sucking and clasping reflexes of the first days of infancy, while winking the eye-lids or jerking the hand away in response to threatening or harmful stimuli are accompanied by consciousness of varying definiteness and clearness. A *sensation-reflex*, as the name implies, is a response to a sensation. The latter is often extremely indefinite and equivocal; but the fact that an activity is preceded or accompanied by consciousness, even though it be vague, serves to mark it off from the pure, or unconscious, reflexes. Jerking the hand away from a hot stove which one touches accidentally, or dodging a missile, may serve as examples of sensation-reflexes. In regard to the position of reflex actions in the scale of human behavior it is clear, to use Judd's words, that "they are primitive in character and far removed from voluntary choice."

Certain of the responses of early infancy that are sometimes described as imitative actions should, perhaps, be classed among the sensation-reflexes. For example, reliable observers have reported instances of babies repeating the actions of others, e. g., movements of the head and arms, protrusion of the lips and tongue, at an age (as early as the fourth month in some cases) that precludes the supposition that they are conscious, or purposive. They are due, apparently, to the fact that in the inherited nervous system of the child there is a close functional connection between the excitation of certain sensory centres in certain specific ways and certain specialized motor responses thereto.

In reference to the same point Kirkpatrick writes, "The extraordinary facility with which children sometimes reproduce sounds which they hear, often without practice, rivaling the accuracy of the phonograph, indicates that there must be a close relation between the centres for sound perceptions and the centres controlling the movement of the vocal organs. The facility with which gestures are imitated indicates that the visual centres are related to the centres controlling arm movements."[1]

Instincts and Instinctive Action: Definition. — Although every one knows in a general way what is meant by an instinctive action, it is, perhaps, impossible to give a definition of the term which will be entirely free from objections. It will be sufficient for our present purposes, however, to say that an instinctive action consists of a series of coördinated, unlearned acts which, when performed, attain a relatively definite, though unforeseen end.

The term 'instinct' is sometimes used as a class name for all instinctive actions; at other times, it means the *impulse*, or *tendency*, to act instinctively. Usually, the context will tell in which of these two meanings the term is used.

Instinctive and Reflex Action. — This definition will serve to mark off roughly the instinctive actions from reflex, volitional, and habitual actions on the

[1] *Genetic Psychology,* 1909, p. 125.

one hand and from the emotions on the other. Thus we may say, following Angell, that an instinctive action differs from a reflexive one mainly in the fact that the former involves a number of acts which taken together lead up to some adaptive consequence, such as the building of a nest, the feeding of young, and the like; whereas, in reflex action the response is simple and immediate. They differ also in the fact that while most reflex acts are neither preceded nor accompanied by consciousness, many instinctive actions, particularly of the higher animals, have well marked conscious antecedents and accompaniments. For example, the mating, nest-building, and migrating instincts of birds are probably preceded by a period of unrest and of indefinite though intense yearning, due, perhaps, to intra-organic changes, the details of which vary from instinct to instinct; and they are also accompanied probably by alternating satisfaction and dissatisfaction according as the course of the action is free or impeded.

Instinctive and Volitional Action. — Instinctive differs from volitional action, first, in the fact that in the latter the agent is conscious of the purpose of the action, while in the former, at any rate on its first occurrence, the end is unforeseen; second, voluntary actions, as we shall see presently, are dependent both as to their origination and nature upon individual experience, whereas instinctive actions are provided for in the inherited structure of the individual's nervous system. As the nature of the sensations which an animal shall experience is determined by the structure and action of its sense-organs, so its instinctive behavior is determined by its inherited nervous organization. The machinery, so to speak, of the instincts is present at birth, or is provided in the natural order of organic growth and development, while in volitional action it is acquired in the course of the individual's experience. In short, volitional actions are actions that are acquired, learned and that are consciously guided; instinctive actions arise and run their course independently of both training and conscious guidance.

Instinct and Habit.—Instinctive and habitual actions have a number of common characteristics, but they differ in one important respect; namely, the former are inherited modes of behavior while the latter are acquired during the life-time of the individual. Another statement of this same distinction is that instinctive actions result from racial experience while habits are the products of individual experience. They differ also in the fact that habitual actions, as a rule, lack the emotional excitement, the physical and mental commotion, that characterize many instinctive actions.

Instinct and Emotion.—Many reactions, human or animal, may be classed as either instinctive or emotional. Thus if one snatches from a child his favorite toy, the child's response is said to be instinctive if we note merely what he *does;* or emotional, if we picture to ourselves his mental state. Or, again, if one suddenly comes upon a fear exciting object, one's *actions* are said to be instinctive, while the mental agitation aroused is called an emotion. In James' words, "an emotion is a tendency to feel [changes in consciousness], and an instinct is a tendency to act characteristically, when in presence of a certain object in the environment."

In respect to the foregoing attempt to mark off the instincts from other forms of behavior, it should be remembered that the distinctions are drawn more or less arbitrarily; further, that many forms of animal behavior resist our best efforts to label them and tuck them away in our schemes of classification, no matter how carefully devised the latter may be. For example, shall we classify a fish's impulse to dart toward and snap up floating particles, the moth's headlong flight into the candle flame, the feigning death of certain animals, as reflexes or as instincts? And shall we call a boy's play-ground battles, or his rush to the circus parade, instinctive or volitional phenomena? And as for the distinction between instinct and emotion, we have seen already that many kinds of behavior which, from one point of view, we call instinctive, from another, may be described as emotional.

**Characteristics of Instincts.** — Having indicated the general nature of instinctive actions, and having seen how they may be marked off roughly from other modes of behavior, we may next consider some of their more special characteristics, or attributes.

(1) Some instincts are delayed in appearing. The statement that a given mode of behavior is inborn, not acquired, need not mean that it makes its appearance immediately after birth. In fact, while some instinctive actions are present from the first, most of them are more or less delayed. The instinct of the newly hatched chick to peck at small objects,

the young robin's instinct to open its mouth to receive food which the parent bird brings, the sucking instinct of the young of mammals, and others which are immediately necessary for the individual's preservation make their appearance very early. On the other hand, the mating, nest-building and migrating instincts of birds are delayed in their appearance for weeks or months. Yet the last three named forms of behavior are as truly inborn, instinctive, as are the first named.

In this connection, one important difference between the human instincts and those of the lower animals may be mentioned; namely, that the former, excepting those immediately necessary to sustain life, are slower in their appearance than the latter. This is another statement of the fact that the period of human infancy is more prolonged, and that human beings reach maturity at a slower rate than do the lower animals. And, speaking generally, in regard to the time, the order, and the conditions of the appearance of the instinctive modes of behavior, we may say that some of them are present from birth, that others are more or less delayed, and that the time and order of their appearance depends upon the needs of the individual organism and of the species to which it belongs.

(2) Instinctive actions are perfected gradually. A second characteristic of instinctive actions is that they are perfected by slow, almost imperceptible steps; there are no sudden leaps in the development of an instinct. Even among the lower forms of animal life, the principle of gradual development holds; thus the young bird does not fly with grace and strength on the first trial, and the cub-lion is able only after practice to stalk and catch his prey. In

like manner, the child's impulses to reach and grasp, to carry things to the mouth, to creep, to stand alone, to walk and talk — all come to perfection gradually.

"To be sure', as the author has said elsewhere, 'the process is more rapid in some lines than in others; but in the most rapid there are no absolute breaks which warrant one in saying, 'at this moment a child lacks a certain ability, the next he has it'. Hence, when it is said that an ability or function seemed to burst forth of a sudden, it should be remembered that its sudden appearance was only seeming and not actual. Of course, in this general statement one excepts such reflex actions as clasping with the fingers, sucking, and a few others which are well developed — though rarely perfect — at birth."[1]

The general rule with reference to the maturing of the instincts which belong more especially to infancy holds with reference to those which arise in later years. Pugnacity, intellectual curiosity, acquisitiveness, the hoarding impulse, constructiveness, interest in the other sex, for example, go through a period of preparation which is controlled in part by the individual's environment, and partly by inner growth changes.

(3) Instincts are interrelated. We saw on a preceding page that it is well-nigh impossible to draw sharp lines of distinction between instinctive and certain other closely related forms of behavior, e. g., the reflexes and the acquired automatisms. We have now to remark that it is equally difficult to distinguish sharply the various forms of instinctive action. This difficulty appears when we undertake

[1] *First Steps in Mental Growth*, p. 9.

to trace an instinct to its beginnings, to search out its earliest forms, and also when we attempt to determine the factors which are operative in producing a given result in a concrete instance of instinctive behavior. In truth, instinctive actions are so intricately interwoven both in their origin and later, after they are well established, that the name which we apply to a given instance of instinctive behavior is somewhat a matter of chance, and in each instance is determined by the special phase, which, for one reason or another, catches our attention. In another work, the author has likened the search for the beginnings of our several instinctive actions to the attempt to trace to their remotest ends the roots of a bed of plants whose stems above ground stand apart, but which spring from a common root-stock or from an inextricable net-work of rootlets. In both cases, the search for beginnings, in the strict sense of that term, is in vain.

It was said in the preceding paragraph that the close interrelation of the instincts is forced upon our attention when we undertake to determine the factors in a concrete instance of instinctive behavior. Suppose, for example, that we seek to account for a child's making a collection of beads or of arrow-heads. If we follow the lead of the popular psychology of instinct we shall be inclined off-hand to ascribe this activity to the collecting instinct, and leave the matter there; but it is likely that a closer study of the case would bring to light several other instinctive factors, e. g., interest in novel or beautiful objects, and emulation, the desire to do what some one else has done and on a larger scale. Similarly, we may say that most of the plays and games of childhood and youth arise from the inter-working of a number of native interests, such as the love of excitement, enjoyment of companionship, and rivalry, in addition to the native delight in mental or physical activity. In a word, concrete cases of instinctive behavior can rarely be accounted for by reference to a single instinct; and the name by which we designate, according to their most conspicuous feature or aspect, individual instances of such behavior should not obscure their other essential features.

(4) Transitoriness of instincts. Transitoriness is characteristic of many instincts, particularly among the lower animals; that is, many instincts ripen at a certain age, then fade away unless they are called into action by appropriate stimuli, and developed into habits. The classic illustration of this characteristic is that if newly hatched chicks are kept from following the mother hen for the first eight or ten days, their instinct to respond to her call and to follow her dies out. This interesting observation, first reported by Spalding in what James described as a 'wonderful article', has been confirmed and supplemented by other observers of animal behavior; and it seems to be well established that the instinct to follow moving objects, which is strong in the young of many species of animals, fades away if its exercise is delayed too long. Another striking illustration of the principle of transitoriness is given by James who relates that a Scotch terrier, brought up

indoors, "made, when he was less than four months old, a very elaborate pretence of burying things, such as gloves, etc., with which he had played till he was tired." But since the conditions were not present to transmute the burying instinct into a food burying habit, the burying impulse was lost.

These instances may serve as illustrations of the transitoriness of the instincts among the lower animals. To what extent human instincts are transitory is a matter about which there is considerable difference of opinion. The trend of the current teaching, however, is on the side of those who, reasoning by analogy, maintain that since the instincts of the lower animals rise and fade away, if at the moment of their greatest vivacity the appropriate objects for their exercise are not present, we may expect a similar law to hold true of man's instincts.

(5) Instincts differ in strength. We have seen (1) that while some instincts are present from the first hours or days of life, others are delayed in their appearance; (2) that they come to perfection gradually; (3) that they are closely interrelated, and (4) that they tend to fade away unless they are exercised. A fifth characteristic is that instincts differ in strength, in the power or energy with which the organism acts under them. First, they differ among themselves, some instincts being more vigorous and imperious than others. For example, the primitive forms of the individualistic, or self-preservative, instincts—feeding, fearing, fighting, and the parental, or racial, instincts—mating and caring for offspring — are stronger, generally speaking, than sympathy,

love of approbation, curiosity, or the collecting and constructive instincts, except in those cases where the appearance of the former depends upon or involves the latter. Secondly, many instincts, which are present all through life, are normally stronger at some periods than at others. Thus, some native tendencies have greatest vivacity in childhood, others in youth, and still others are characteristic of manhood and womanhood. For example, childhood is the period of play and the love of physical activity for its own sake, of sensational curiosity, and the tendency to imitate others' actions; youth is marked by the social instincts of love of approbation, love of society, sympathy and shyness, by the advent of the mating instincts, pugnacity, desire for mastery, and frequently an intellectual form of curiosity; while love of achievement, the struggle for place, power, and influence, as well as sympathy and altruism in their broader scope, are characteristic of manhood and womanhood.

The pedagogical implications of the foregoing distinctions have been impressively set forth by James as follows:

"In children we observe a ripening of impulses and interests in a certain determinate order. Creeping, walking, climbing, imitating vocal sounds, constructing, drawing, calculating, possess the child in succession; in some children the possession while it lasts may be of a semi-frantic and exclusive sort. Later the interest in any one of these things may wholly fade away."[1] And again in another place he writes: "There is a happy moment for fixing skill in drawing, for making boys collectors in natural history, and pres-

[1] *Talks to Teachers on Psychology*, p. 61.

ently dissectors and botanists; then for initiating them into the harmonies of mechanics and the wonders of physical and chemical law. Later introspective psychology and the metaphysical and religious mysteries take their turn; and, last of all, the drama of human affairs and worldly wisdom in the widest sense of the term."[1]

In the third place, we find enormous differences in the strength of the several instincts as we go from individual to individual. Thus instinctive pugnacity, fear, play, manipulation, curiosity, love of companionship, interest in beautiful objects, or in making collections, exist in different children in all grades of intensity from the lowest to the highest. One child is all pugnacity and courage; another flees at the first scent of danger and fights only as a last resort. Some children are naturally curious about everything, are interested in the beautiful in nature and art, and enjoy human society; others are seemingly devoid of curiosity, care nothing for beautiful objects, and would rather spend their days in solitude. No doubt education and experience are influential in developing and establishing these variations; nevertheless, differences in the native vigor of the instincts are perfectly evident and unequivocal. And it is equally clear that the immense range of differences among grown persons, in respect to their efficiency and character, is due in large measure to the differences in the strength of their individual instinctive tendencies.

(6) Definite and indefinite instincts. Some instincts are definite, uniform, fixed; others are indefi-

[1] *Text-Book of Psychology*, p. 405.

nite, vague, and variable. The comb-building of honey bees, the web spinning of spiders, the nest-building of most birds, are examples of instinctive actions which are the same, or nearly the same, at all times and in all places, and so are said to be 'fixed' or 'definite'. That is, unaffected by changes in place or circumstances, the honey bee builds the same kind of honey-comb, the spider weaves the same sort of web, the oriole's nest is made in the same way, generation after generation. In marked contrast with behavior of this determinate, mechanical sort are the calf's instinct to follow any moving object — its mother, a horse, a man — or the chick's instinct to peck at all kinds of small objects — crumbs of meal, flies, nail heads, bits of yarn, a patch of sun-light — or the little child's instinctive fear of strange objects, strange cats, dogs, horses, persons, which may serve as illustrations of 'indefinite', 'variable' instincts. The calf's instinct to follow moving objects, the chick's to peck at small objects, the child's native fear of strange things are general, not definite, specialized tendencies. If, however, calves always followed the mother cow and her only, if chicks pecked only at edible worms, if little children feared only strange dogs, then we should characterize the calf's instinct to follow, the chick's to peck, the child's to fear — as fixed, definite, specialized.

The biological meaning of the varying definiteness of instinctive behavior is that if the environment of a given animal is simple, and so requires only a small number of adjustments for its own preservation and that of its species, then the more prominent, relatively, is the animal's stock of definite instincts. On the other hand, a complex environment, a large variety of necessary adjustments, requires a stock of indefinite, variable instincts. Contrast, for example, the relatively simple environment of birds and the relatively definite conditions of their survival with man's highly complex environment and the highly variable conditions of his survival. Corresponding to this marked difference, we find, on the one hand, the definite nest-building, migrating, and food-gathering instincts of birds, and on the other, a group of highly variable and indefinite instincts which control man's activities to provide food and shelter. Thus, to give only one illustration, the impulse to provide a place of shelter for the young appears among birds as the definite nest-building instinct and in man as the highly variable home-building impulse.

A corollary of the foregoing distinction of instincts as definite and indefinite is that those animals which possess a large number of indefinite instincts are more educable, and have, other things equal, greater possibilities of mental development than those whose instincts are definite and invariable. Indeed, the terms 'definiteness', 'fixedness', when applied to instincts, mean that they are unmodifiable, and so are not subject to the influences of training and education, while 'indefiniteness,' 'variability' mean the possibility of modification through training and experience.

No doubt the high degree of educability of children is due, in good measure, to the indefiniteness of their instinctive curiosity, mental activity, imitativeness, pugnacity, love of physical activity, emulation and sociability; or, put in another way, if these instincts were definite, fixed, instead of indefinite and variable, children would be far less educable than they are. Contrast, e. g., the curiosity of one of the lower animals, say that of a fox, which arises only in relation to those things—places of shelter and hiding, enemies, things to eat or avoid — which are useful or harmful to him and his kind in the struggle for existence, with the curiosity of the normal child, his impulse to better cognition, which is, within the limits of his experience, unlimited, and constitutes, as Kirkpatrick says, the basis of his intellectual development.

(7) Instincts are modifiable. Closely related to indefiniteness which, as we have just seen, is characteristic of many instincts, is their susceptibility to modification, which may occur in any one of three ways: (1) they may be suppressed, temporarily or permanently, if (a) their exercise is accompanied by discomfort, as when a child's impulse to pet a dog is met by angry snarls, or when an animal learns from experience to shun certain kinds of traps; or if (b), according to the principle of transiency already mentioned, the situations or objects which usually evoke them are absent, as when a child's love of games and sports and companionship fails to appear, or dies out, from lack of exercise.

(2) Instinctive tendencies are also susceptible to modification in that their original direction may be changed. Familiar illustrations are — turning a boy's inborn pugnacity and his native love of physical activity to learning to do useful kinds of work; or redirecting a child's curiosity about implements

of savage warfare to a study of primitive man's mode of life, customs, language, religion; or a teacher's transforming individual rivalry or selfishness into loyalty and jealous regard for the good name of the class or school to which the individual belongs.

(3) Instinctive actions tend to pass into habits when they are accompanied by satisfaction. Thus, to quote two of Thorndike's illustrations:

> "The child who instinctively says *baba* or *mama* in its mother's presence and is rewarded by parental attention and petting, forms the habit of calling her by that name. The chick, in the ordinary course of events, follows the hen for a few days because of instinct, but from the second time on the force of habit combines with that of inner nature; so that by the eighth or tenth day (when the instinct, if left to itself, would have vanished) the chick continues the now habitual act."[1]

**The Principal Instincts and their Classification.** — The problem of distinguishing and classifying the principal instinctive actions is, for several reasons, one of great difficulty. In the first place, these actions are, as we saw in the preceding section, so intricately interwoven that we can hardly hope to catalogue their various forms so that each shall be sharply marked off from all others. Secondly, many forms of behavior that are clearly instinctive in one species of animals, e. g., the play, or the collecting, or the constructive activities of certain animals, are not unequivocally instinctive in other species; hence, a description or a classification that is valid for one group of animals may not be valid for others. In

[1] *Elements of Psychology*, 1905, p. 189.

the third place, it is extremely difficult to attach a fixed meaning to the term 'instinct', for the reason, already mentioned, that instinctive behavior shades by imperceptible degrees into reflex action on the one side and into habitual and purposive actions on the other. It may also be observed that there is no obviously natural principle of classifying instinctive actions, and that the classifications proposed by different authors are based upon principles chosen somewhat arbitrarily, with the result that they are widely divergent.

The catalogue and classification of the instincts given in the succeeding paragraphs is a modification of the one proposed by Marshall in his *Instinct and Reason,* and employed with certain changes by Kirkpatrick in his *Fundamentals of Child Study,* and later, with some further modification, in his *Genetic Psychology.*

In these works, instinctive activities are classified according to the uses which they subserve. According to this principle of classification we are able to distinguish roughly five classes of instincts: (1) the individualistic; (2) the parental; (3) the social, which together constitute the group of fundamental, or primary adaptive, instincts; (4) the secondary adaptive instincts, and (5) a group consisting of derived or specialized forms of the fundamental modes of instinctive behavior. We shall describe the classes in the order named.

**Individualistic or Self-Preservative Instincts.** — To this class belong all instinctive actions whose primary use is the preservation of the individual reacting. "The most fundamental and universal form of this instinct," says Kirkpatrick, "is the tendency to contract the body and withdraw from unfavorable stimuli, and to expand or approach toward favorable ones." In all animals, except the lowest, this general tendency just mentioned is specialized into three fairly distinct groups of actions; first, those connected with the feeding process; second, those which are of use to the individual in escaping danger; third, those useful in fighting enemies or rivals; or briefly, the *feeding, fearing, fighting,* instincts.

(1) The Feeding Instinct. — Perhaps the most striking feature of this form of animal behavior is the enormous variety of devices employed by different species of animals for securing food. Thus, to instance only a few of them, the amœba, which has no stomach or mouth, simply wraps itself around its food and absorbs the digestible particles; the spider weaves a web in which its hapless prey becomes enmeshed; the young robin opens its mouth to receive food which is brought to it; the chick or duckling runs down and snaps up butterflies and grasshoppers; the kitten lies in wait for its prey and pounces upon it when it appears; and the young of many of our domesticated animals, pigs and calves, e. g., search the mother for food in ways which leave no doubt as to their instinctive character.

Almost equally curious are the food-storing activities of many species of animals. One example from the multitudes which are described in books on animal life will suffice.

"In the case of the California woodpecker," write Jordan and Kellogg in *Evolution and Animal Life*, "a large number together select a live-oak tree for their operations. They first bore its bark full of holes, each large enough to hold an acorn. Then into each hole an acorn is thrust. Only one tree in several square miles may be selected, and when their work is finished all those interested go about their business elsewhere. At irregular intervals a dozen or so come back with much clamorous discussion to look at the tree. When the right time comes, they all return, open the acorns one by one, devouring apparently the substance of the nut, and probably also the grubs of beetles which have developed within. When the nuts are ripe, again they return to the same tree and the same process is repeated. In the tree figured [in the text] this has been noticed each year since 1891."[1]

(2) Fear. — Fear, the instinct to escape danger, according to the authors just quoted, is even more varied in its manifestations, than the feeding instinct. Among the lower animals, the usual modes of escaping danger are, — running away, flight, crouching and hiding, uttering terrifying sounds, and by the use of the defensive weapons for biting, scratching, shocking, and stinging. More curious are, — feigning death when danger threatens, the zigzag flight which many insects employ to elude their pursuers, emitting offensive odors when attacked, or fluids, which furnish the animal concealment from its enemy, assuming a threatening or terrifying appearance, the instinct of porcupines and the European hedgehog to seek protection in their thorny armatures.

[1] *Evolution and Animal Life*, 1907, p. 433.

Children's Fears. There are two general causes of the fear-reaction in little children: first, strange and powerful sense-impressions which shock or jar the child's unstable nervous system; and second, apprehension, vague or clear, of possible danger.

(a) Sound Fears. Observers of infancy agree that the earliest instances of this reaction are in response to loud and sudden noises, such as are made by the slamming of doors, the falling of articles of furniture, or loud calls. In these cases, we have to do not with the instinct of fear, strictly speaking, but, as Sully observes, "with an organic phenomenon, with a sort of jar to the nervous system."

"To understand this," Sully continues, "we have to remember that the ear, in the case of man at least, is the sense-organ through which the nervous system is most powerfully and profoundly acted on. Sounds seem to go through us, to shake us, to pound and crush us. A child of four months or six months has a nervous organization still weak and unstable, and we should naturally expect loud sounds to produce a disturbing effect on it." [1]

Volume, or bigness, of sounds is mentioned by a number of writers as a property which tends to make them fearful. Adults as well as children often feel a vague alarm or uneasiness at the roar of a storm, the firing of heavy artillery, the noise of a big factory, the din of a city street, the noise of great volumes of water rushing over a precipice, as at Niagara, mainly because of the overwhelming nature of the sounds produced. In these cases the immediate effect is physical rather than mental; the

[1] *Studies of Childhood*, p. 197.

very bigness of the noise pounds, overwhelms, crushes one, producing a "panicky" feeling, although one may be well aware all the while that there is no danger of physical harm.

(b) Fear of visible things. We have seen that the child's first fear responses are reflex and not easily distinguishable from physical shock or jar; also that his earliest fear reactions are produced by sounds, and that sound is the most fertile source of fear in adults as well as in children. But we also instinctively fear visible things which are strange or powerful or which are sudden in appearance. Thus we have an instinctive dread of strange people, strange places, strange animals; we are frightened, at least for an instant, if any one, even our best friend rushes upon us from hiding; and powerful visual impressions like those produced by great sea waves, by the rush of heavy, lowering clouds, a violent storm, a great conflagration, the irresistibleness of a great water-fall, the advance of an army of soldiers — are terrifying to many persons, and in even the stoutest hearts they cause apprehension and uneasiness closely akin to fear.

(c) Fear of animals — "How happens it,' asked Preyer,[1] 'that many children are afraid of dogs, pigs and cats, before they know the dangerous qualities of those animals?" How happens it that many children show fear of animals at so early an age that we can hardly suppose that the fear is due to ideas of possible harm? The question has been variously answered. Preyer, Darwin, Hall, James, and others believe the early animal fears to be instinctive. Hall,

[1] *The Mind of the Child,* Vol. I. p. 164.

for example, says of animal fears, "More than any others, these fears seem like lapsed reflexes, fragments and relics of psychic states and acts which are now rarely seen in all their former vigor."[1] Others believe that most, perhaps all, animal fears are due in the first instance, either to the strangeness of the animals, or to suggestion of possible harm by the speech or actions of the child's companions. In the first case, animals are looked upon as intruders, they disturb the order of things to which the child is habituated, or if the animal jumps about, frisks, or utters cries of any sort, it becomes still more frightful. The writer's observations cause him to doubt that children have an instinctive fear of particular kinds of animals; they seem to show, on the contrary, that animal fears are either merely special cases of the instinctive fear of all strange things; or, are due to suggestion, from some source, of possible harm.

(3) Fighting. — Fighting bears the same relation to anger that the group of defensive movements does to fear. Popularly stated, whatever arouses an animal's anger also excites to action its inherited fighting machinery. Among the lower animals the most general causes of anger, and so of the instinct to fight, are the appearance of an enemy, thwarting the gratification of native or acquired impulses, the infliction of bodily pain, or the interruption of a pleasant sense-experience. Additional and special causes of anger in man are — interference with his plans or purposes, memories of past insults or injuries, and thoughts of possible future ones.

[1] *Amer. Jour. of Psychology*, Vol. VIII, p. 205 ff.

The instinctive modes of fighting are as varied, and many of them are as curious, as are the instinctive modes of securing food or of escaping danger. Thus, to instance only the more common ones, animals fight by biting, striking, kicking, scratching, hooking, butting, stinging, pecking, stamping, squeezing, and by hurling missiles. Few brute species employ more than two of these methods of assailing their enemies, while man, whom James characterizes as in many respects "the most ruthlessly ferocious of beasts," employs almost all that are known among the lower animals and many more besides of his own devising.

Parental or Racial Instincts. — The list of racial instincts includes the instincts of courtship, fighting for mates, the sex impulse, nest-building and home-making, guarding and brooding eggs, feeding the young and protecting them from their enemies. In brief, all instinctive actions which are concerned in the reproduction and care of the young belong to this group. It is evident that they, together with the individualistic instincts, constitute by far the greater part of the activities of the animal world.

The Social Instincts. — Those animal instincts which are developed by group or community life, and which are fostered because of their usefulness to the group as a group, are called social instincts. Three principal ways in which the social instinct is manifested may be mentioned: (1) *gregariousness,* the tendency to seek the companionship of others; (2) *sympathy,* the impulse to respond in kind to the emotional expressions of others; (3) *coöperative-*

*ness,* shown in action with others for a common end, and for the good of the group, or society.

(1) Gregariousness. — Man is sometimes described as *the* gregarious animal; and Angell declares that, "the man or child who in one form or another does not natively crave companionship . . . is essentially insane." Love of companionship is also characteristic of many animals whose progenitors banded together in flocks or herds, originally, perhaps, for protection and help. "Indeed, the more one studies the habits of animals," say Jordan and Kellogg, "the more examples of social life and mutual help will be found. Probably most animals are in some degree gregarious in habit."

(2) Sympathetic action, in so far as it is instinctive, is expressive of the innate responsiveness of an animal to the emotional expressions of its companions. Stated otherwise, the instinctive sympathetic responses of certain of the higher animals and of man depend upon the fact that their organisms are partially tuned to respond in kind to certain emotional expressions that are characteristic of their species. An instinctive emotional expression by one member of a species tends to awaken a similar action in other present members of the species. For instance, the spread of the flight impulse, and its correlative, fear, in a flock, herd or crowd, is often due to this inherited tendency. One animal of a flock or herd gives what is for the species a danger signal, e. g., utters a characteristic warning cry, and instantly all of its members take to flight or shelter. "Children,' Kirkpatrick remarks, 'readily cry in ter-

ror, or laugh with glee when those around do so." The so-called 'expressions' of the emotions of anger, love, joy, grief, disgust, and perhaps others of the 'coarser' emotions, are contagious in this way; so that we may, within limits, speak of the contagion of both emotion and instinct.

(3) Coöperativeness. — The instinct to act for the good of the social group is seen in its simplest and most striking forms in the communal life of the social bees, ants, and wasps where 'the division of labor is such that the individual is dependent for its continual existence on the community as a whole; and also in those instances of animals banding together for temporary advantage, as when a pack of wolves coöperate to obtain food, when beavers unite to build a dam, or in the curious group activity sometimes employed by pelicans in catching fish.

Authorities are fairly well agreed that the activities enumerated in the foregoing paragraphs should be classed among the instincts. The food-gathering and food-storing activities, modes of fighting, of escaping danger, the parental impulses, gregariousness, responsiveness to an animal group's characteristic emotional expressions, are, at any rate on their first occurrence, and among most animals, quite certainly instinctive. But when we pass to the study of such activities as play, imitativeness, constructiveness, acquisitiveness, communicativeness, bodily adornment, and certain others, we encounter a wide diversity of opinion, the grounds whereof were mentioned on page 371 f. The nature of the difficulty in respect to these activities can be made clearer by two or three examples. The play activities, for instance, of some animals are undoubtedly instinctive; one cannot observe the play of kittens, calves, lambs, puppies, and doubt that they are determined by their inherited nervous organizations. But it is not so clear that the play of little children is instinctive, although it is only one step removed from tendencies and capacities which are pretty certainly so. The same observation holds in reference to the constructive and collecting activities. Among certain of the lower animals, e. g., birds, bees, beavers, ants, spiders, constructiveness is a genuinely instinctive mode of behavior. The collecting impulse, or acquisitiveness, is no less certainly instinctive in many species of animals, and it occurs sometimes entirely apart apparently from any relation it might have to the animal's bodily needs. But it is extremely doubtful if constructiveness and acquisitiveness should be included in a list of human instincts, although they too are built upon tendencies and capacities that are themselves most assuredly innate.

With these reservations and restrictions in reference to the use of the term instinctive in describing or accounting for a given form of behavior, let us turn next to the two remaining groups of our list.

Secondary Adaptive Instincts. — All instinctive actions have been useful in the struggle for existence and so have adaptive value, otherwise they would not have been preserved. The groups already considered — the individualistic, the parental, and the social instincts — seem, however, to be directly and immediately valuable in the animals' struggle with their environment, so have been designated the 'primary' adaptive instincts. Two other forms of instinctive behavior — play and curiosity — are also adaptive in function; but since their adaptive value is not so immediate or direct as that of the instincts included in our first three classes, they may be called the 'secondary' adaptive instincts.

(1) Play. — Efforts to explain play activities have given rise to a number of theories, the best known ones being those of Spencer, an English philosopher; Groos, a German investigator, and Hall, an American psychologist. Spencer's theory that play results from the superabundance of energy of childhood and youth, though still the popular explanation of the origin of the play activities, has been given up by the more careful students, who accept either Groos' theory or Hall's, or a combination of these. Groos' theory is, in brief, that the play of animals and of man is closely related to and determined by their general instinctive endowment, and that when playing an animal "uses the same powers that his ancestors have used in gaining food, avoiding enemies, and securing the perpetuation of the species, and thus exercises the powers he will himself need to use when no longer protected by parental care."[1]

Concerning Groos' theory, Hall writes:

"The view of Groos that play is practice for future adult activities is very partial, superficial, and perverse. It ignores the past where lie the keys to all play activities. . . . . In place of this mistaken and misleading view, I regard play as

[1] KIRKPATRICK, *Child Study*, p. 147.

the motor habits and spirit of the past of the race, persisting in the present, as rudimentary functions sometimes of and always akin to rudimentary organs . . . . In play every mood and movement is instinct with heredity. Thus we rehearse the activities of our ancestors, back we know not how far, and repeat their life work in summative and adumbrated ways. It is reminiscent, albeit unconsciously, of our line of descent; and each is the key to the other. The psycho-motive impulses that prompt it are the forms in which our forbears have transmitted to us their habitual activities."[1]

The principal difference between the theories of Groos and Hall seems to be that the former regards the play of the young as a preparation for adult activities, while the latter sees in play merely an echo of long past racial experiences. Groos thinks play is a kind of looking forward to the future; Hall, that it is reminiscent of a far distant past. Groos lays emphasis on the use, or adaptive function, of the play activities; Hall is content to point out merely that play is a rehearsal of ancestral activities; he ignores the question as to whether it is or is not useful. We may accept both theories: Hall's as to the origin of play, and Groos' as to the function which it serves in animal life.

(2) Curiosity. — Curiosity may be defined as hunger for new experiences, as the desire to secure and to test new sensations, as 'an impulse toward better cognition.' It is pretty evident that an animal that possesses this impulse, provided it is properly checked by caution or timidity, has an advantage in the struggle for existence over an animal that lacks it. The former will learn more about

[1] *Youth,* 1908, p. 73 f.

the advantageous and dangerous features of its environment — about things to eat or to avoid, places of hiding, enemies to shun — and so becomes more quickly adapted to its surroundings, than the latter. The adaptive value of curiosity to childhood is still more evident. As Kirkpatrick remarks, 'necessity is a great teacher, but curiosity is a greater teacher in early life'; and the story of man's struggle for mastery over nature is, in large part, a narrative of his achievements under the guidance of his intellectual curiosity.

Derived or Specialized Instincts. — This group includes a number of specialized forms of the fundamental, or primary adaptive, instincts. Among the most prominent of these derived forms of behavior are: (1) the collecting impulse, or acquisitiveness, the tendency to make collections of all sorts of things; (2) the manipulating impulse, or the constructive and destructive tendencies; (3) the instinct of adornment; (4) the migratory instinct; (5) the expressive instinct, the impulse to communicate one's ideas and feelings to one's companions.

As the group-name indicates, these forms of behavior originated probably in the fundamental instincts. For example, the collecting and the manipulating instincts were developed from the food-gathering, food-storing, and home-making activities; and the instinct to communicate to others one's feelings and ideas originated in the experience that signs, gestures, or vocal sounds, which are indicative of advantageous or dangerous features of the animal environment, were useful in the struggle for existence. In their later development, the resultant instincts are so closely related to others that their identity is somewhat obscured. The collecting impulse, for instance, as found in man is often prompted and supported by emulation and by æsthetic or play interests; that is, many of the collections which men make are prompted by rivalry or by the desire to gratify some æsthetic or play interest. Again, many of the constructive activities, so-called, of little children, e. g., in building a house or bridge of blocks, may also be described, at least from the point of view of the on-looker, as either play or imitative behavior, since in fact the children *are* playing, and they *are* imitating the actions of older persons.

Habit: Definition.—Any fixed mode of behavior which a person has acquired by practice or repetition is called a 'habit'. Instances of what in everyday life we call 'personal habits' abound on all sides. We have habits of walking, of greeting our friends, of taking our meals, of clothing our bodies, of signing our names, of thinking and feeling about the various questions and problems which we meet from day to day. So dominant a feature is habit in the lives of most grown persons that their round of daily activities is made up in large measure of actions performed as habit decrees.

Man's most conspicuous habits are bodily, or physical, in character. Thus the drink habit, the tobacco habit, habits of carrying the body in walking, habits of speech, mannerisms and idiosyncrasies of one kind or another usually come to mind when one asks for examples of human habits. But man, particularly civilized man, has also innumerable mental habits, i. e., fixed tendencies of feeling, thinking, resolving, in given situations. Moreover, man possesses many habits that are partly mental and partly physical in character; they cannot be definitely classed in either group. Examples are — playing a musical instrument, oral reading, spelling and writing in easy composition.

The sway of habit is seen not only in human conduct but also in the behavior of the lower animals. Thus domesticated animals acquire habits of expecting food and shelter at certain times and places, of responding in fixed ways to the master's voice, of liking or disliking their brute companions. Wild animals make their way to the same places from day to day in search of food and shelter, and to escape from their habitual enemies.

**The Conditions of Habit Formation.** — There are three general conditions of the formation of habits in living things. First, the law of nature that things tend to act as they have acted before. Second, habit formation in animate things depends upon the plasticity of the organic materials of which they are composed. By 'plasticity' is meant, to use James' words, "the possession of a structure weak enough to yield to an influence, but strong enough not to yield all at once. Organic matter, especially nervous tissue', James observes, 'seems endowed with a very extraordinary degree of plasticity of this sort." As a third condition of the formation of habits in living things, physiologists cite also the law that living organs tend to grow to the mode in which they are habitually exercised. Thus if the muscles are practiced in the performance of an act of skill, the growth processes tend often 'to corroborate and fix the impressed modification.' Especially in growing and plastic bodies, the growth changes which occur during the period of recuperation following intensive practice — say in running a scale on the piano, in learning to operate a telegraph instrument, or to write a given script — consist, in part, in building up and strengthening the tissues involved in the exercise. This accounts for the fact, frequently noted, that in acquiring the manual arts one's skill increases as if by a sudden leap during the period of rest following a period of hard practice, so that when the exercise is resumed the learner finds himself much more proficient than when the practice was discontinued. The observation of this fact has led a German author, quoted by James, to say "that we learn to swim during the winter and to skate during the summer."

Habit and Instinct. — In the paragraph on 'the transitoriness of instincts', it was said that under given conditions instincts tend to pass into habits. The principal condition of this transition is that an instinctive action shall yield satisfaction; if, on the other hand, it yields dissatisfaction, it is inhibited or fades away. The principle of control, and the process by which instincts, at first vague and indefinite, pass, through exercise, into fixed habits of behavior are illustrated in Morgan's account of his chicks acquiring the habit of pecking at and swallowing desirable objects and of avoiding undesirable ones. At first, the chicks pecked indiscriminately at whatever was placed before them — bits of yarn, match heads, tacks, worms edible and inedible — any small object that stood out from its surroundings; but they soon learned from experience which ones produced agreeable gustatory results and which disagreeble ones; and they formed the habit of picking up and swallowing the former and of avoiding the latter.[1]

Thorndike's report, which follows, of a kitten's method of learning to open the door of a cage, in which it was confined, in order to get food, affords another excellent illustration of the way in which habits are developed from instincts:

"If we take a box twenty by fifteen by twelve inches, replace its cover and front side by bars an inch apart, and make in this front side a door arranged so as to fall open when a wooden button inside is turned from a vertical to a horizontal position, we shall have means to observe another simple case of learning. A kitten, three to six months old, if put in this box when hungry, a bit of fish being left outside, reacts as follows: It tries to squeeze through between the bars, claws at the bars and at loose things in and out of the box, reaches its paws out between the bars, and bites at its confining walls. Some one of all these promiscuous clawings, squeezings, and bitings turn round the wooden button, and the kitten gains freedom and food. By repeating the experience again and again, the animal gradually comes to omit all the useless clawings, etc., and to manifest only the particular impulse (e. g., to claw hard at the top of the button with the paw, or to push against one side of it with the nose) which has resulted successfully. It turns the button round without delay whenever put in the box. It has

[1] MORGAN, *An Introduction to Comparative Psychology*, 1902, chs. V. XII.

formed an association between the situation, 'confinement in a box of a certain appearance,' and the impulse to the act of clawing at a certain part of that box in a certain definite way." [1]

The same principle, namely, that instinctive actions which bring satisfaction are selected and that those which bring discomfort or are useless are eliminated, explains why certain special forms of a child's instinctive behavior pass into habits and why certain others disappear. For example, a child may either grab and cry for articles of food at the table, or he may imitatively ask politely for them. In the former case, he is either punished or his request is denied; in the latter, he gets the food, and also praise and smiles of approval. In time, the child learns to inhibit the grabbing-crying for food impulses and to employ the socially approved methods of securing these goods. In brief, to repeat in substance, the general principle formulated by Thorndike: any form of behavior which, in a given situation, results pleasurably tends to recur upon the recurrence of the situation; and further that any form of behavior which, in a given situation, brings discomfort is likely to be inhibited on the recurrence of the situation.

The Nature of Voluntary Action. — A simple voluntary action consists of three easily discernible factors: (1) an image or idea of the action itself or of its total or partial results — the initial factor; (2) the desire that the action or result thus imaged or thought of shall follow; (3) the conscious control

[1] *Elements of Psychology,* 1905, p. 201 f.

of the muscular movements appropriate thereto. Thus in such simple actions as signing one's name, or playing a musical chord, or pitching a ball — if they are really voluntary — we have foresight of the end to be attained, we desire that end, and we consciously set about its attainment. We may next consider briefly each of these three main factors.

Foresight of the purpose of the action. — We have said that the initiative factor of a voluntary action may be an image or an idea either of the action itself or of its results. For example, one may picture either pulling the gun-trigger or hitting the mark, swinging the ax or the tree's falling. In the voluntary actions of the normal adult, the idea of the result to be attained is the principal controlling and initiating factor. When, for instance, the student pays out money to get a book or to have a place to room and board or to see a ball game, the end of the action is the determining factor. Occasionally, however, the purpose which controls a voluntary action is an image or idea of the action itself. The behavior of children affords numerous instances of actions of this sort, e. g., blinking, altering the rate of breathing, clinching the fists, odd gestures, antics of all kinds which terminate in the child's own body, and which have no purpose beyond themselves.

Desire as a factor in voluntary action.—We have seen in the preceding paragraph that a simple voluntary act includes as an essential factor an idea of varying clearness of the action itself or of its result; there must be foresight of the outcome of the action.

But evidently it includes more than this anticipatory factor, since we foresee many of our actions which are in no sense voluntary. For instance, we may clearly foresee that we shall continue breathing so long as life lasts, that we shall perform countless actions from sheer habit, that we shall show grief when misfortune befalls us, that we shall eat when hungry and rest when weary, but we do not call these actions voluntary. In addition to the factor of foresight, an action in order to be voluntary must be definitely desired. And in order that an action shall be desired the image or thought thereof must touch our feelings in some way, or it must be related to some of our inborn tendencies, or it must accord with a previously formed plan. Stated otherwise, the action must either be clustered over with a tone of pleasantness or unpleasantness, or it must grow out of some of our instinctive longings, or it must be congruous with some earlier conceived purpose. To illustrate: the idea of obtaining a university degree or of visiting a foreign country arouses desire because the idea has a pleasurable feeling tone; again, the dislike of being beaten by a difficulty or of being surpassed by one's fellow students gets part of its character from the impulse of pugnacity, or mastery, in the one case and from our native impulse to emulation in the other; and the desire to draw a check in payment of a debt traces back either to one's habit of paying one's debts or to the earlier intention to pay this particular one.

The term 'desire' as used here includes both its positive form, as the desire for good health, friends, etc., and also its negative form, 'aversion', with which, in ordinary speech, desire is contrasted. This seems warranted since aversion to, the recoil from, a disagreeable thing is in fact a desire to get rid of it. Our meaning is substantially the same whether we say that we are averse to the tooth-ache, to foggy weather, to unfriendly criticism, or that we desire painless teeth, fair weather, the good opinion of our fellows.

The motor factor.—We have seen that a voluntary action involves, first, an idea of the end to be attained — the initiating feature and the principal factor of control; second, a sense of the value of the foreseen end, which we may call the sustaining factor. We may consider next the motor factor, i.e., the method whereby the appropriate movements are guided to the attainment of the desired end.

In the everyday life of the normal adult the motor features of voluntary actions are controlled chiefly, though not exclusively, by visual, auditory, and kinæsthetic sensations, perceptions and images. The manner in which these factors operate to control simple voluntary actions may be seen from two simple experiments:

First, select a point on the floor of your study-room eight or ten feet distant from where you are sitting. Call this point a mark. Then watch carefully the factors which control your tossing some object, such as an eraser, a nail, or a coin, so that it will light on the mark. The guiding factors will be found to be, first and chiefly, the fixation of the eyes on the mark which controls the direction of the toss; second, one may detect sensations from the hand and arm, which serve to gauge the amount of exertion required. That is, the factors which control such a movement are — the perception of the mark, and a group of kinæsthetic sensations from the muscles, tendons, and joints of hand and arm. As a second experiment, let the student observe the factors present in recalling and singing a half-forgotten melody. He may, possibly, first recall some of the words as they would look in print or sound when spoken; next he may hear, in the mind's ear, some of the notes or measures; at the same time he may have, possibly, sensations of strain and twitching from the muscles of the throat and the vocal cords. That is, it is possible that all three factors — the visual, auditory, and kinæsthetic, shall operate in the control of the voice. But, as is well known, the manner in which singing is started and controlled differs greatly among individuals. Thus one person guides his voice mainly by the imaged tones, another by a visual image of the printed music, a third by a group of sensations mainly from the throat and vocal cords. The type of control which is employed in a given case will depend in part upon the singing habits and training of the individual, and in part upon his characteristic image-processes — whether visual, auditory, kinæsthetic, or mixed. The results of these experiments may be taken as typical of what one finds upon analysis of the motor side of any simple voluntary action. We may next consider some of the ways in which our volitional activity is complicated.

**Deliberation.** — We have observed on several occasions that the attempt to isolate and detach elements or features of a total experience, for purposes of better scrutiny and description, is likely to result in a partial and distorted view of the actual course of events. This observation is pertinent in respect to our study of simple voluntary action, since, as is obvious enough, such actions do not arise, in real life, uninfluenced by antecedent events, and since a full explanation of a given voluntary act must include an historical account of its forerunners. In fact our voluntary actions, as is frequently remarked, are expressions of our total character; they have a long history which traces back through the influences and activities of all our past life to our individual native endowments. But leaving aside this more comprehensive view of volitional actions, we may pass at once to the study of Deliberation which, in the opinion of many psychologists, is a characteristic of all voluntary action.

We must first distinguish deliberation from the simple conflict or rivalry of incompatible instinctive tendencies. The latter may be found at a relatively early stage of mental development, e. g., in the actions of little children and in the behavior of many of the lower animals. Darwin's well-known description of the behavior of a cage-full of monkeys when a paper bag containing a small snake was placed in their cage, gives us a striking picture of the operation of the contrary impulses of curiosity and timidity.[1] Other familiar illustrations of the conflict of simple impulsive tendencies are seen in a little child's desire to pat a strange dog and his fear of him, and in the fox's greed and his suspicion of the baited trap. In these cases of conflict of impulse with impulse, we have one of the first signs of what James has described as the 'masking' of the real nature of our instincts. But we should not call them cases of deliberation. The latter process presupposes a much higher stage of intellectual development than the simple push and pull of conflicting impulses. In its simplest form, deliberation pre-

[1] *The Descent of Man,* 1871, Vol. I, p. 42.

supposes at least some effort to foresee the immediate consequences of the various proposed actions; in its more highly developed form, we ask how each of the several possible actions, if realized, would affect our entire future, how they accord with our larger plans and purposes, e. g., our purpose to secure a college education, or our ideals of personal character. Our first observation then is that deliberation is to be distinguished sharply from the oscillation between conflicting instinctive tendencies. We may next inquire more fully as to its chief characteristics.

In actual life, deliberation occurs in a vast variety of forms and with many complications. Ordinarily, however, its distinctive features are readily determined. It is sometimes described as a mental seesaw, as a series of attentions to two or more conflicting possibilities. Now one alternative, now another appears vividly in consciousness and we are alternately attracted and repelled by each. It consists, in Titchener's words, of "an active weighing of motives . . . . a series of judgments or of active imagings" in regard to the conflicting purposes. We compare their values as possible sources of pleasure or pain, good or evil. These weighings, comparisons, judgments, constitute the thought phase of deliberation. The process has also a feeling side which may be either of pleasantness or of unpleasantness. If the conflict is accepted as a matter of course, or is regarded as an inescapable affair, one's attitude may be, temporarily, one of either resignation or despair; or if the situation does not demand an immediate solution, and if neither weal nor woe, prosperity nor ruin, is a possibility of the final outcome, that is, if we think the decision when it does come will not greatly affect our fortunes either for good or for ill, we may even delight in the difficulty and the intellectual gymnastic which it affords. If, however, an immediate decision is demanded, or if it is foreseen that the decision when it does come will be of momentous import for all our future, then we may experience the disagreeable emotions of confusion, anxiety, or even of what James calls 'the dread of the irrevocable'. The state of deliberation is also marked by the feeling of effort which may be either pleasant or painful; the former when we are confident of our ability to find the right solution to our problem and painful when our courage pales.

**Decision.** — The principal ways in which cases of deliberation are concluded and decisions reached, 'the chief types of decision', they were called by James, are three. To the first type, belong those decisions which follow the calm and persistent balancing of the advantages and disadvantages of the several possible courses of action. After a period of careful weighing and measuring, one course seems so clearly better than any other that the decision seems like following the line of least resistance. We may acknowledge the merits of the rejected possibilities; but we believe that those of the accepted one are so definitely superior that we go forward cheerfully and confidently in the execution of our plans.

In a second type, deliberation, strictly speaking, has reached a dead-lock and has ceased; neither side preponderates, we have a drawn battle, and our decision hangs in the balance. Then some chance occurence, often trivial in itself, tips the scales and our destiny is fixed. For example, the writer knows a case in which a young man had considered long and earnestly which of three colleges he would attend, but was unable to reach a decision until he was told that a certain man, whom he greatly admired, attended a certain one of them a half century before. That ended the matter; he would go there.

A third type of decision is characterized by marked feelings of effort and anxiety. Circumstances demand some sort of a decision and one is made. Meantime we are sure that we are sacrificing possible goods, and we are tortured by the fear that our choice may work out disastrously. Of this type of decision James writes:

"Whether it be the dreary resignation, for the sake of austere and naked duty, of all sorts of rich mundane delights, or whether it be the heavy resolve that of two mutually exclusive trains of future fact, both sweet and good, and with no strictly objective or imperative principle of choice between them, one shall forevermore become impossible, while the other shall become reality, it is a desolate and acrid sort of act, an excursion into a lonesome moral wilderness. If examined closely, its chief difference from the . . . . former cases appears to be that in those the mind, at the moment of deciding on the triumphant alternative, dropped the other one wholly or nearly out of sight, whereas here both alternatives are steadily held in view, and in the very act of murdering the vanquished possibility the chooser realizes how much in that instant he is making himself lose. It is deliberately driving a thorn into one's flesh; and the sense of *inward effort* with which the act is accompanied is an element which sets [this] type of decision in strong contrast with the previous varieties, and makes of it an altogether peculiar sort of mental phenomenon."[1]

The Consciousness of Effort. — The consciousness of effort, which, as we have seen, is present in both deliberation and decision, calls for a few further words. Every one knows in a general way the nature of this experience since it is a conspicuous feature of our daily life. Mental or physical strain, exertion, struggle, up-hill work, wearing toil, are the experiences which readily come to one's mind as 'effort's' congeners. But the questions of the *origin* of the consciousness of effort, and of what it is in its innermost nature, are matters about which, as James, says, 'the gravest difference of opinion prevails. Questions as momentous as that of the very existence of spiritual causality, as vast as that of universal predestination or free-will, depend on its interpretation'.[2] More particularly, the question in debate is: Does the consciousness of effort consist, in part at least, of a consciousness of mental activity? is it made up partly of the awareness of the presence and work of a spiritual force called the 'Will'? or does the feeling of effort consist entirely of a mixture of sensations from contracting muscles, tendons, labored breathing, accelerated heart action, and other bodily changes?

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[1] *Principles of Psychology*, II, p. 534.
[2] *Op. cit.*, II; 535.

In order to avoid confusion in considering this question, we must first distinguish very sharply, as Angell says, in substance, between the question as to the *fact* of mental activity of the volitional kind and the question as to what are the conscious representatives of this activity.[1] There can be no doubt as to the former; it is a feature of every act of deliberation, of every decision, every determination to act or not to act, as well as of all our overt, volitional actions. The controversy is in regard to the second question, namely, are we conscious in volitional actions of the activity of a 'Will' over and above a mass of sensations, feelings, ideas, judgments? And is the consciousness of mental activity an unique and essential factor of the consciousness of effort? In regard to this question, it must be said that the weight of introspective testimony is against the presence of such additional conscious factor, and in favor of the view that the consciousness of effort is due entirely to the sensations which originate in the action of the muscles, joints, tendons, organs of respiration, circulation and possibly other vasomotor processes.

It is clear that this way of conceiving of the nature and origin of the feeling of effort, that is, to reduce it to a mass of bodily sensations plus a feeling-tone of pleasantness or unpleasantness, inevitably leads to our classing it among the emotions; and this some writers, e. g., Angell, definitely do. In that case, we may say, paraphrasing James' chief argument in support of his theory of the emotions, "if we strip from the feeling of effort the sensations arising from the harder breathing, the heightened heart action, the tense, swelling muscles, we shall find that our feeling of effort has

[1] *Psychology,* 428.

evaporated. . . A disembodied consciousness of effort is a sheer non-entity."

**The Conditions of Effort.**—Leaving out of account the feeling of effort due to the performance of mere physical feats, such as climbing a steep mountain, swimming against the current, or lifting a heavy weight, we may next enumerate certain additional conditions of effort, or of conflict, which, as was said, is its most general condition. We have just seen that deliberation and decision are frequently attended by marked feelings of effort. In both, the conflict is either between our impulsive, or habitual tendencies on the one hand and ideal motives on the other or between ideal motives which are equally attractive but which are seen to be incompatible.

Earliest in appearance and perhaps simplest in form is the effort experienced when one, for prudential reasons, resists a strong inborn impulse. A familiar example is the effort a boy feels when he resists, from fear of punishment or from a sense of duty, the impulse to follow his play instincts and sticks to an assigned piece of work which he dislikes. Indeed, the whole round of lessons in self-restraint which the child must learn are so many occasions of the feeling of effort. Briefly, the inhibition of our more imperious racial tendencies is the first and most evident condition of this experience.

In the second place, effort is experienced when we endure pain for the sake of future good, or to escape a greater pain, as when one clinches his fists and braces himself to undergo a dental operation in order to have sound teeth, to lessen the chances of impaired digestion, or to escape the reproach of having toothless gums.

In the third place, effort is felt when we are required to act contrary to our habitual modes of acting. This principle finds application in situations differing as widely as using a fork in eating when one's habit is to use a knife and assuming a reverential attitude in a religious ceremony when one is commonly irreverent in regard to things religious. It accounts in part for our awkwardness in social gatherings, for our anxiety when suddenly called upon to act in novel situations, in short, for the confusion and perturbation we experience whenever our habitual modes of behavior, personal or professional, our accustomed manner, attitudes or emotional responses are inadequate to, or are out of harmony with, the demands of the moment.

Fourth, the consciousness of effort arises when one is required to choose one of two incompatible ideal courses of action. Much of life's mental distress grows out of conflicts of this kind. The good citizen desires the rigid enforcement of the law; but this would enmesh some of his best personal friends, so he hesitates. The young man wishes to enter the missionary field, but this would require him to leave his aged parents. Brutus would serve both his friend and benefactor, Cæsar, and Rome which he loves so well:

> 'The genius and the mortal instruments
> Are then in council; and the state of man,
> Like to a little kingdom, suffers then
> The nature of an insurrection.'

**Internal Volitional Activity.** — Thus far, our account of volitional activity has pertained chiefly to bodily movements, such as mowing the lawn, making a journey, or going to college, *external* voluntary actions as they are sometimes called. We must now supplement this partial view by a brief account of the inner or *internal* voluntary actions, that is, the volitional control of the changes in the stream of our mental life. If we compare internal voluntary actions with external ones, we find that they differ merely in the fact that whereas, in the latter, the controlling and sustaining ideas relate to some sort of bodily action or its result, in the former, they pertain primarily to mental changes, to mental processes which are only indirectly, and sometimes remotely, related to bodily actions. As examples of the volitional control of our mental processes, one thinks, first, of the recollection of forgotten data, e. g., the names of persons and places, or the details of some event in our past lives, or certain facts of history, literature, or science. In these cases, we speak of 'willing' to recall the forgotten items. Next, one might instance 'thinking' in all of its forms, e. g., 'willing' to compare the intensity of two auditory sensations, to find the predicate in a Latin sentence, to analyze a complex fact or situation into its elements, or to judge as to the soundness of a given argument. One might also mention the volitional control of the constructive or creative imagination, as in designing a machine, in planning a house, or in composing music. It is also possible to control or modify voluntarily the emotional life. This control may consist either in the excitation or repression, partial or complete, of the emotional processes. For instance, it is possible (as we saw on p. 322, note) to arouse a wide range of emotions by assuming their outward form. We may 'will' to be joyous or sad, kindly or ill-tempered, light-hearted or gloomy, credulous or suspicious, to believe or doubt, to be brave or to show the white feather, to be terror-stricken or calm and self-possessed, by assuming the appropriate bodily attitudes and by keeping vividly in consciousness the ideas and images which support the emotion that we are seeking to arouse. A familiar example of the second form of control of the emotions is the repression or reduction of an emotional outburst, e. g., of anger, by inhibiting its motor expressions — the clenched fist, the set jaw, the rigid muscles, the hard breathing of the passion. Finally, we may say that any mental process or state, simple or complex, which may be an object of thought may also be the end or terminus of a volitional process. Sometimes the end of the process is reached directly by a series of mental processes; sometimes indirectly by a series of bodily movements, as in the case of the emotions, just mentioned.

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# INDEX OF NAMES AND SUBJECTS


Abstraction, thought as, 247 ff.
Actions, kinds of, 354.
After-images, visual, 88 ff.
  negative and positive distinguished, 89 ff.
Analysis, as a thought-process, 276 ff.
  conditions of, 279.
ANGELL, on relation of vegetative processes to sense of well-being, 54.
  on motor images, 150 f.
  on instinctive and reflex action, 357 f.
  on gregarious instinct, 379.
  on mental activity, 399.
  on consciousness of effort, 399.
Articular sensations, 112.
Association, meaning of the term, 187.
Association areas in cortex, 36.
  function of, 37.
Association fibres, 33.
Associative neurones, 66.
Associative connections, 185 ff.
  variations among, 189 ff.
Associations, conditions of formation of, 193 ff.
Auditory nerve terminations, 62 f.
Auditory sensations, 97 ff.
Automatic movements, 354 f.
Attention, the nature of, 161 ff.
  the conditions of, 163 ff.
  the motor concomitants of, 170.
  the sensory concomitants of, 173 ff.
  the degrees of, 174 ff.
  the range of, 176 ff.
  the forms of, 178.
  voluntary, 179.
  involuntary, 179.
  non-voluntary, 180.
  popular view of, 181.
Beats, 102.
Brain, described, 19 ff.
CALKINS on components of pain sensations, 111.
  on involuntariness of perception, 140, 153, 156.
Cerebral convolutions and fissures, 24.
Cerebral functions, localization of, 38 ff.
Cerebral lobes and inter-lobar fissures, 24 ff.
Cerebral peduncles, 22.
Cerebellum, 22 f.
Cerebrum, 23 ff
  white matter of, 31 ff.
Color blindness, 91 ff.
  statistics of, 92.
  inheritance of, 92 f.
  tests for, 93 f.
Color mixture, 86 ff.
Color pyramid, 84 f.
Color zones of retina, 94 ff.
Commissural fibres, 34.
Comparison as a thought-process, 269 ff.
  Sully on, 269.
  Stout on, 269.
  conditions of, 270 ff.
CONDILLAC quoted, 75.
Consciousness meaning of term, 1.
  synonyms of, 1 f.
  and nervous system, 14 ff.
  function of human, 351 ff.
Co-operation, instinctive, 380 f.
Cortex, the cerebral, 28 ff.
  the cell-bodies of, 30.
  nerve fibres of, 31 f.
Cortical areas, three types of, 34 ff.
Cranial nerves, 49 f.

Cramming, 222 ff.
Jevons on value of, 223.
James on, 224.
Abercromble on, 224.
SULLY on, 223.
Titchener on, 225.
Curiosity, 383 f.
Cutaneous sensations, 107 ff.
DARWIN on fear, 316.
on rage, 317.
on genesis of emotional reactions, 326 ff.
on contrary impulses of curiosity and timidity, 394.
Decision, James, chief types of, 396.
Deliberation, 393 ff.
Dewey, reference, 325.
Discrimination, 272 ff.
and differentiation, 273 f.
individual differences in, 274 ff.
DONALDSON, on inheritance of color-blindness, 93.
EBBINGHAUS, on influence of association on feelingtone of experience, 313.
Effort, consciousness of, 398 f.
conditions of, 400 f.
Emotion, meaning of the term, 315.
distinctive mark of, 315.
factors of, 316 ff.
and feeling, 317 f.
cognitive factor in, 319.
James-Lange theory of, 319 ff.
and sentiment compared, 334 ff.
and instinct, 359 f.
Emotional reactions, genesis of, 325 ff.
Equivocal figures, 131 ff.
Fear, bodily signs of, 316.
instinct of, 374 ff.
in children, 375 ff.
FECHNER, pioneer study of imagery, 146.
Feeling, meaning of the term, 289 f.
number of kinds of, 291 ff.
the mental conditions of, 295 ff.
as function of the attributes of sensations, 295.
and organic sensations, 296 ff.
and conative tendencies, 296 ff.
and instinctive tendencies, 297 f.
dependent on both special and organic sensations, 301 f.
and attributes of intensity and duration, 303 f.
the neural correlates of, 304 ff
and anabolic and katabolic processes, 306 f.
and hindrance and furtherance, 307 ff.
and habit, 309 f.
and association, 312 f.
transference of, 313 f.
as a factor in emotion, 317 f.
Feeding instinct, 373 f.
Fighting instinct, 377 f.
FLECHSIG, on association areas, 36.
FLOURENS, on functions of cerebrum, 39.
FRITSCH and HITZIG, on localization of cerebral functions, 39.
GALL'S phrenology, 38 f.
GALTON'S questionaire on imagery, 147 f.
on verbal imagery, 152, 155.
Generalization, 281 ff.
General ideas, origin of, 283 ff.
Gregariousness an instinct, 378 f.
GROOS, theory of play, 382 f.
Habit, definition of, 385.
conditions of habit formation, 386.
and instinct, 359, 371.
HALL, on fear of animals, 376 f.
on play, 382 f.
Hallucination, 133 ff.

HARDESTY, quoted, 19.
on sympathetic nervous system, 51 ff.
Harmonic intervals, 102.
HOBBES, on association, 186.
HOWELL, on function of cerebellum, 22 f.
on termination of taste-fibres, 41.
on color-blindness, 91 ff.
HUXLEY, use of term psychosis, 2.
statement of law of psychoneural perallelism, 15.
Idea and image, how differ, 143 ff.
Idea and ideate, the terms, 246 f.
Ideation, thought as, 246 f.
relation of judgment and, 255 f.
Illusions of perception, 125 ff.
classes of, 126.
of abnormal consciousness, 130.
Illusion figures, 128 f.
Image and percept compared, 138 ff.
and idea compared, 143 ff.
Images, type, 145.
class, 145 f.
Imagery, individual differences in, 146 ff.
Galton's questionaire on, 147 f.
types of mental, 149 f.
symbol, 152.
verbal, 154 ff.
differences in the attributes of characteristic, 157 ff.
Imaginal and ideational processes, sequence of, 205 ff.
Imagination, defined, 228.
Imaginative activity, types of, 228 ff.
limits of, 231 ff.
passive and active ditinguished, 233 f.
beginnings of, 234 ff.
individual differences in, 237 ff.
Imitative actions, as sensation reflexes, 356 f.
Individual differences in mental imagery, 146 ff.
Instinctive actions, definition, 357.
and reflexes, 357.
and volitional actions, 358 f.
and habit, 359.
Instincts, and emotion, 359 f.
characteristics of, 360 ff.
delayed, 360 f.
are perfected gradually 361 f.
are interrelated, 362 ff.
transitoriness of, 364 f.
differences in strength of, 365 ff.
definite and indefinite, 367 ff.
are modifiable, 370 f.
tend to pass into habits, 371.
classification of the principal, 371 ff.
individualistic, 372 ff.
parental or racial, 378.
social, 378 ff.
primary and secondary adaptive, 381 f.
resultant or specialized, 384 f.
masking of, 394.
JAMES, on function of association areas, 38.
on nature of sensation, 71.
definition of perception, 116.
on hallucination, 134 f.
on faculty of imagination, 146.
on memory consciousness, 200 f.
on associative revival, 208.
on the value of cramming, 224.
on the nature of thinking, 241.
on the conditions of analysis, 279 f.
on generalization as a psychic state, 281 f.
on emotion, 319 ff.

on the genesis of emotional reactions, 327.
on function of human consciousness, 351 f.
on appearance of instincts, 366 f.
on chief types of decision, 396 ff.
on consciousness of effort, 398.
JAMES-LANGE theory of Emotion, 319 ff.
objections to, 322 ff.
JORDAN and KELLOGG, on food-storing activities of certain animals, 374.
JUDD, on association by similarity, 213.
on effects of nervous impulses, 353 f.
Judgment, thought as, 252.
as synthesis, 252.
of objective relations, 253 f.
and reasoning, 256 f.
Kinaesthetic senses, 111 f.
Kinaesthetic images, Angell and Titchener on question of, 150 f.
KIRKPATRICK, on imitative actions, 357.
on the classification of instincts, 372.
statement of Groos' theory of play, 382.
KÜLPE, on quality as sensation attribute, 78.
on sensory concomitants of attention, 173 f.
LADD, on feelings of pleasure, 294.
on sentiment, 338.
LANGE, JAMES — theory of emotion, 391 ff.
MARSHALL, on classification of instincts, 372
McDOUGALL, on 'storing' of ideas, 202.
on feeling-tone of sensation, 302.
Medulla oblongata, 21.
Memory, definition of, 198.
factors of a, 198 ff.
the conditions of, 201 ff.
and imagery, 216 f.
individual differences in, 218 ff.
Memories, Hamilton on prodigious, 226 f.
Mental blindness, 43.
Mental deafness, 43.
Mental image, term defined, 137.
Mental imagery, types of, 149 f.
MENTELLI, a typical intellectual miser, 342.
MILL, J. S. on function of thought, 243.
Mind, meaning of term, 1;184.
Mixed type of imagery, described by Titchener, 151.
MORGAN, on habit formation in chicks, 387.
Motor cortical areas, 35 f.
Motor neurones and motor organs, 66.
Movements, automatic, 354 f.
Muscular sensations, 112.
Nervous system, general view of, 17 ff.
divisions of, 19.
Neurone, 55 f.
Neurones, chief groups of, 55 f.
Sensory and sense organs 57 ff.
Olfactory stimulus, 103 f.
Optic nerve fibres, termination of, 63 f.
Organic sensations, 114 f.
Titchener on knowledge of, 114.
as factors of emotion, 316 f., 320 f.
and tone of consciousness, 53, 355.
Pain, sensation of, 110 f.
Perception, defined, 116.
and sensation distinguished, 117.

genesis of, 118 ff.
illusions of, 126 ff.
Perceptual stimuli, variations of, 122 f.
Perceptions of particular things, variations in, 123 ff.
Percept and image compared, 138 ff.
Peripheral nervous system, 48 ff.
Phrenology of Gall and Spurzheim, 34 f.
PIERSOL, on structure of otolith membrane, 113.
PILLSBURY, on the neural basis of hallucinations, 135.
experiment on attention, 168.
on the range of attention, 177 f.
Pitch, 99.
Play, theories of Spencer, Groos, and Hall, concerning, 382 ff.
Pons Varolii, 21 f.
Pressure, sensations of, 108.
PREYER, on children's fears, 376.
Projection fibres, 31 f.
Psychology, defined, 1.
divisions of the field of, 2 f.
normal and abnormal distinguished, 2.
Titchener's classification of the fields of, 4.
the methods of, 5 f.
points of view, 7 ff.
subject-matter of introductory course in, 11 ff.
Psycho-neural correlation, law of, 15.
Pure sensation, 74 f.
Racial instincts, 378.
Rage, symptoms of, 317.
Reasoning, judgment and, 256 f.
defined, 257.
explicit, 258 f.
and reasoned judgments distinguished, 260 f.
implicit, 262 f.
inductive and deductive, distinguished, 264 f.
Recall, active and passive distinguished, 214 ff.
Recollection, 214, 402.
Reflex action, defined, 355.
pure, and sensation reflexes distinguished, 356 f.
imitative actions as, 356 f.
Retention, how explained, 203 f.
Retina, 64 f.
color zones of, 94 ff.
Revival, the process of, 204 f.
secondary laws of associative, 207 ff.
spontaneous, 210 f.
through similarity, 211 ff.
RIBOT, quotation from Mentelli's biography, 342.
SEASHORE, on color zones of retina, 96.
on distinction of pain and unpleasantness, 110.
questions on imagery, 149 f., 158, 159.
Sensation, defined, 69.
as mental element, 69 f.
and stimulus, 71 f.
cognitive function of, 72 f.
as earliest form of consciousness, 73 f.
pure, 74 f.
attributes of, 77 ff.
Sensations, classification of, 80 f.
visual, 82 ff.
auditory, 97 ff.
of smell, 103 ff.
of taste, 105 ff.
cutaneous, 107 ff.
of pressure, 108.
of temperature, 109.
of pain, 110 f.
kinaesthetic, 111 ff.
organic, 114 f.
Sensory cortical centers, 35 f.
Sensory endings, free, 59.
encapsulated, 59 f.

Sensory qualities, differentiation of, 75 ff.
Sense-organs, the special, 61 ff.
Sentiment, meaning of the term, 333.
and emotion compared, 334 ff.
Stout on, 336.
Shand, on, 338 f.
Sentiments, intellectual, 340 ff.
moral, 342 ff.
aesthetic, 347 ff.
SHAND, on nature of sentiment, 333 f.
Similarity, revival through, 211 ff.
Smell, organ of, 62.
relations of sensations of, 104.
classes of sensations of, 104 f.
Social instincts, 378 ff.
Somaesthetic area in cortex, 41 f.
Spinal cord, structure of, 44 f.
functions of, 46 f.
Spinal nerves, 51.
SPURZHEIM'S phrenology, 38 f.
Stimulus defined, 71 f.
maximal and minimal, 71 f.
STOUT, on distinction between cause of sensation and the object of sense-perception, 72.
on the difference between percept and image, 140.
on verbal imagery, 153.
on the conditions of association, 195.
on the serviceableness of memory, 219 f.
on comparison, 269.
on feeling and conative tendencies, 296 f.
on question, are pleasant stimuli beneficial, 306.
on the James-Lange theory of emotion, 323 ff.
on sentiment, 333 ff.
on relation of emotion and sentiment, 336.
on organic sensations, 355.
SULLY, influence of association on feeling-tone of experience, 312 f.
on beginnings of aesthetic sentiment, 348.
on sound fears, 375.
Sympathetic nervous system, 51 ff.
Sympathy, instinctive, 379.
Taste, organs of, 61.
distribuation of organs of, 105 f.
Taste sensations, classes and relations of, 106 f.
TAYLOR, on location of motor region of cortex, 35.
on connections of the auditory nerves, 36.
Temperature, sensations of, 109 f.
Tendinous sensations, 112.
Thinking, the nature of, 241 ff.
THORNDIKE, on function of associative neurones, 67.
on development of world of sense, 71.
on tendency of instincts to pass into habits, 371.
on development of habits from instincts, 388.
Thought as ideation, 245 f.
as abstraction, 247 ff.
as judgment, 251.
vehicles of, 266 ff.
beginnings of, 286 ff.
Thought-processes, as functions, 243 f.
classes of, 244 f.
Timbre, 101 f.
TITCHENER, classification of psychology by, 3 f.
on function of free sensory nerve endings, 59.

on the functions of various encapsulated sensory endings, 59 f.
on sensation as structural element, 70.
on the attributes of sensation, 78 f.
on colour mixture, 87 f.
on the difference between tones and noises, 99.
on difference tones, 102 f.
classification of sensations of smell, 104 f.
on antagonistic tastes, 107.
on sensations of pressure, 108.
on distribution of temperature organs, 109.
on touch blends, 113 f.
on weight illusion, 133.
on mental imagery, 148.
on mixed types of imagery, 151.
on auditory-kinaesthetic images, 157.
on the memory consciousness, 200 f.
on cramming, 225.
on the development of the concept 'attribute', 250 f.
on general ideas, 282.
on the term 'feeling', 289.
on Wundt's tridimensional theory of feeling, 293 f.
Tones and noises distinguished, 99.
Tones, attributes of, 99 f.
classes of, 101 f.
compound, 101.
difference, 102.
Touch-blends, Titchener's, 113 f.
Verbal imagery, James on, 154.
kinds of, 154 f.
Calkins on, 156.
Visual sensations, classes of, 82 f.
Volitional action, the nature of, 389 ff.
factors in, 389 ff.
Volitional activity, internal, 402.
WASHBURN, on the origin of the consciousness of 'if', 'but', etc., 267 f.
'Will', the alleged consciousness of a, 398 f.
WUNDT, on localization of cerebral functions, 40 ff.
kinds of feeling according to, 292 f.
on the James-Lange theory of emotion, 322 f.
Zones, retinal, 94 f.

# INDEX OF FIGURES.


| FIGURE. | | PAGE. |
|---|---|---|
| 1. | Nervous System, General arrangement of human. | 16 |
| 2. | Central Nervous System, ventral aspect of the.. | 18 |
| 3. | Brain, inferior aspect of human................ | 20 |
| 4. | Brain, superior aspect of human.............. | 23 |
| 5. | Brain, lateral aspect of human................ | 25 |
| 6. | Brain, mesial aspect of human................. | 26 |
| 7. | Cortex, section of............................ | 30 |
| 8. | Peduncular fibres of cerebrum................. | 32 |
| 9. | Association fibres of cerebrum................ | 33 |
| 10. | Commissural fibres of cerebrum................ | 34 |
| 11. | Cross-section of spinal cord.................. | 45 |
| 12. | Principal functions of spinal cord............ | 47 |
| 13. | Sympathetic nervous system, general plan and connections of............................ | 52 |
| 14. | Typical cell-bodies of neurones................ | 54 |
| 15. | Phylogenetic and ontogenetic development of nerve cells ................................ | 56 |
| 16A. | End-bulb of Krause........................... | 58 |
| 16B. | Meissner corpuscle ........................... | 58 |
| 16C. | Motor 'end-plate' in voluntary muscle.......... | 58 |
| 16D. | Free sensory nerve endings.................... | 58 |
| 16E. | Motor termination in non-striated muscles....... | 58 |
| 16F. | Termination of sensory nerve in tendon........ | 58 |
| 16G. | Pacinian corpuscle ........................... | 58 |
| 17. | Taste-bud .................................... | 61 |
| 18. | Olfactory cells ............................... | 62 |
| 19. | Diagrammatic section through right ear........ | 63 |
| 20. | Horizontal section through left eye............ | 64 |
| 21. | Diagrammatic section of the retina............ | 65 |
| 22. | The color pyramid............................. | 84 |
| 23. | The color circle............................... | 88 |
| 24. | Figure to demonstrate negative after-image.... | 90 |

FIGURE. PAGE.
25. Color fields of right eye........................ 95
26. Properties of sound waves...................... 98
27. Illusion figures: Müller-Lyer and Zöllner....... 128
28. Illusion figures: Hering's, et. al................ 129
29. Equivocal figure: rabbit-duck................... 130
30. Equivocal figure: superimposed triangles....... 131
31. Equivocal figures ............................ 132
32. Diagram illustrating variations in degrees of attention ................................ 177
33. Diagram of association through similarity...... 213
34. Diagram of Wundt's three dimensions of feeling. 292

846